SPICER®

DANA

Service Manual

Spicer® Tandem Drive Axles

AXSM-1951

September 1997

S400-S

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GENUINE SPICER SERVICE PARTS

Should an axle assembly require replacement component parts, it is recommended that Spicer Heavy Axle Service Parts be used. Spicer Heavy Axle Service Parts are manufactured under the same rigid specification as are original equipment axle components. This assures the customer who uses genuine Spicer service parts, maximum reliability for a Spicer Heavy Axle assembly. They may be obtained through your vehicle manufacturer.

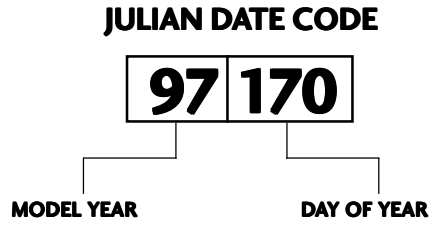
The use of non-original Spicer service parts may cause premature component failure and may void the warranty.

The items included in this book are currently being offered as service parts at the time of printing. The part numbers and illustrations are provided specifically for reference purposes only. Therefore, Spicer reserves the right to update this manual without notice or liability.

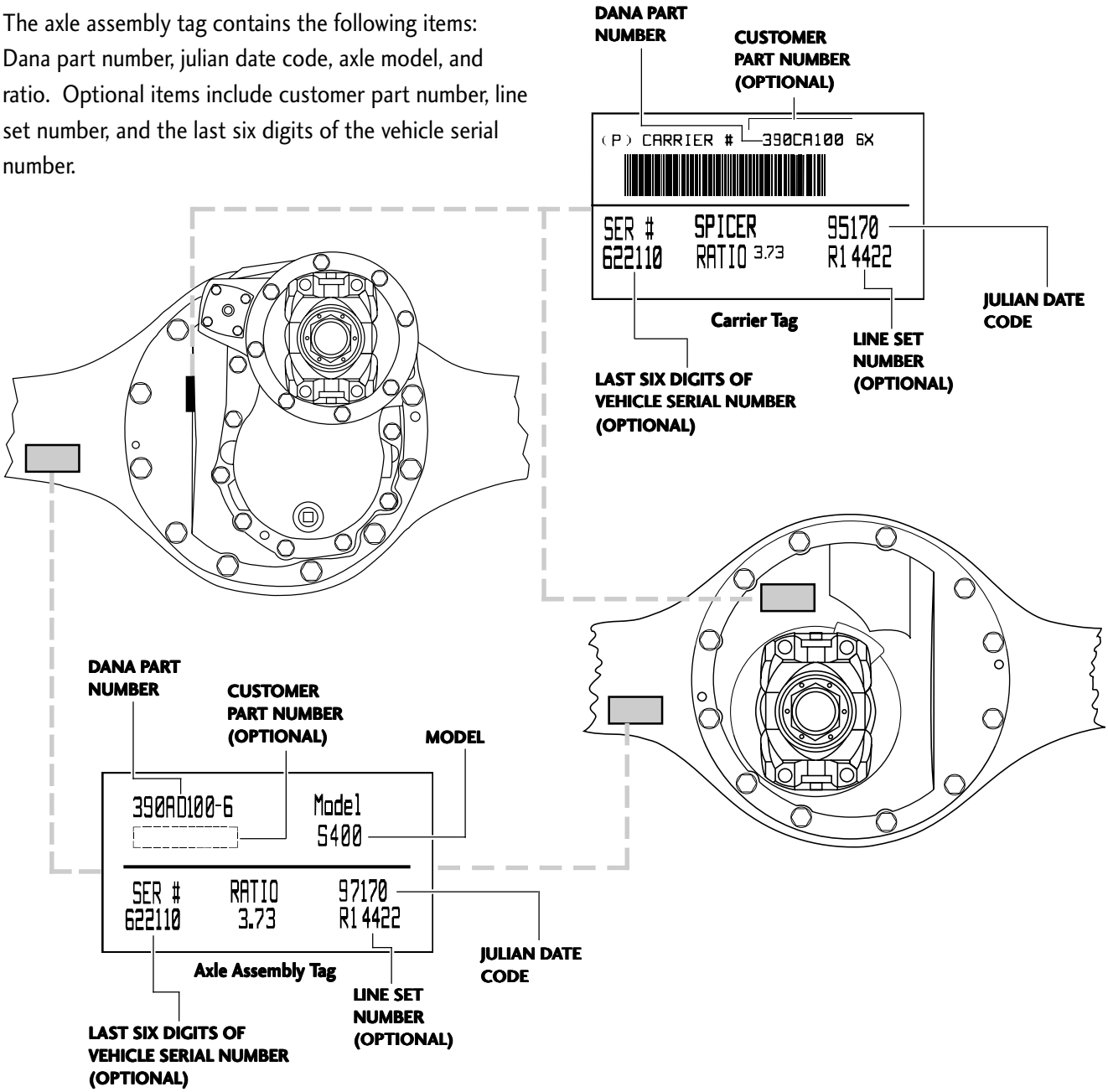
AXLE IDENTIFICATION

All axle assemblies are identified with two tags. One located on the differential carrier, and the other located on the right hand side of the axle housing.

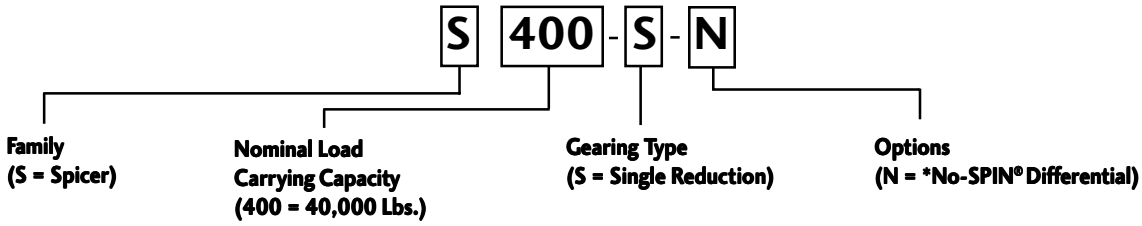
The differential carrier tag contains the following: Dana part number, julian date code, and ratio. Optional items include customer part number, line set number, and the last six digits of the vehicle serial number.



The axle assembly tag contains the following items: Dana part number, julian date code, axle model, and ratio. Optional items include customer part number, line set number, and the last six digits of the vehicle serial number.



MODEL IDENTIFICATION NUMBERING SYSTEM



** No-SPIN® is a registered trademark of Tractech*

GEAR SET IDENTIFICATION

Manufacturer's Date- Date gear set was made.

Spicer Trademark- Company logo and location of manufacturing facility.

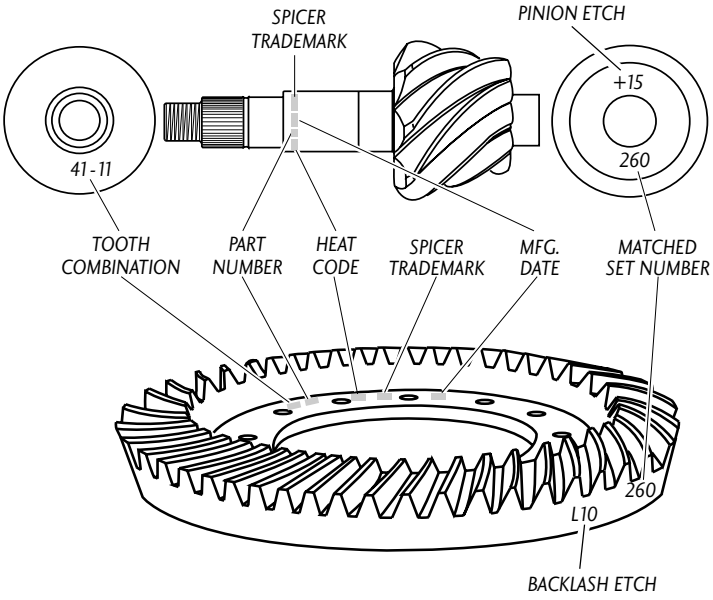
Part number of pinion- 390GP100 (TYPICAL)

Tooth Combination(i.e. 41-11)- Indicates the pinion has 11 teeth and the ring gear has 41 teeth which results in a 3:73:1 ratio.

Matched Set Number- Spicer ring gears and pinions are manufactured as matched sets. Both ring gear and pinion are marked with a corresponding number (i.e. 260), which identifies them as a matched set.

A gear set that does not have the same match set numbers should not be run together. If either ring gear or pinion require replacement, a new matched set must be used.

Backlash etch- Indicates backlash setting for assembly.



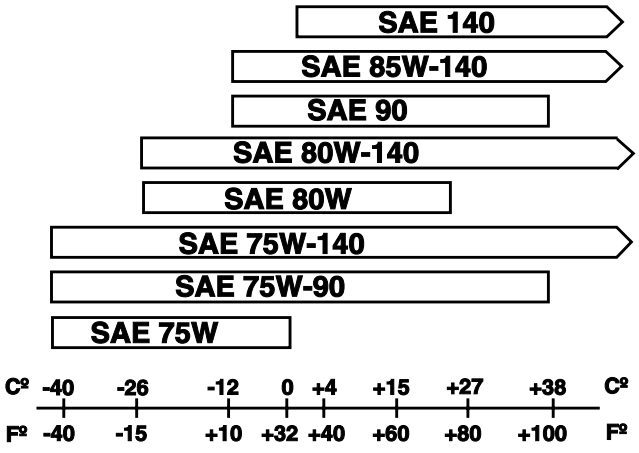
AXLE LUBRICANT RECOMMENDATIONS

To ensure proper lubrication and operating temperature, correct lubricants and lubricant levels must be obtained.

RECOMMENDED LUBRICANTS

Petroleum based or synthetic based hypoid gear lubricants that meet or exceed military specification MIL-L-2105D, and API service classification GL-5, are the minimum requirements for use in Spicer Medium and Heavy Duty Drive Axles.

The table below indicates which SAE viscosities are recommended for various temperature ranges the vehicle will encounter.



AMBIENT AIR TEMPERATURE

SERVICE

Recommended lubricant change intervals are dependent on the application and operating environment. The following chart should be used to establish proper change intervals.

SUBMERSION OR DEEP WATER FORDING

In the event the axle assembly should become submerged in water, particularly if over the vent or breather, it is recommended that the lubricant be drained to prevent water damage and/or contamination. The axle assembly should then be refilled with specified lubricant.

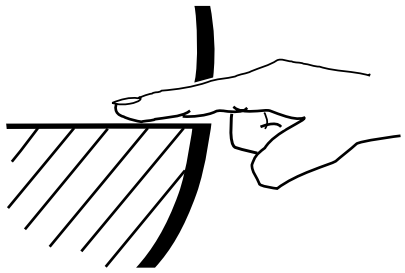
APPLICATION	PETROLEUM BASED		SYNTHETIC BASED**	
	MILES	INTERVAL	MILES	INTERVAL
On Highway	100,000	1 Year	250,000	3 Year
* Severe Service and On-Off Highway	50,000	1 Year	100,000	1 Year

* Severe service includes any applications operating at or near maximum GVW or GCW ratings. This includes normally wet or dusty environment, or consistent high load and low speed applications.

** Includes Semi-Synthetic blends that meet MIL-L-2105D specifications.

AFTER OVERHAUL OR CHANGE INTERVALS

Fill the axle assembly to the bottom of housing fill hole as shown in the illustration below. It is recommended that following an overhaul, each side of the axle be jacked up separately to approximately six inches and held into position for one minute. This procedure will allow adequate lubricant to flow into the wheel ends and help eliminate the possibility of premature damage to wheel bearings and seals. Lower the vehicle to the floor and allow ten minutes for lube to return to normal level. Check and refill assembly to bottom of fill hole to replace the lubricant that was directed into the wheel ends.



NOTE: Lubricant close enough to the bottom of the fill hole to be seen or touched is not sufficient. Lubricant must be level with the fill hole.

GENERAL PRECAUTIONS

⚠ IMPORTANT ⚠

READ THIS SECTION BEFORE STARTING ANY SERVICE PROCEDURES

GENERAL AXLE DESCRIPTION

The Spicer tandem rear axle assemblies consist of two heavy duty, hypoid, single reduction differential carrier assemblies. The forward axle contains a power divider, which does exactly what its name implies. It divides power between the forward rear and rear rear axle assemblies.

The forward axle receives power through a set of helical gears within the power divider. The rear rear axle receives power from the power divider output shaft that extends through the forward axle housing. The complete forward axle differential carrier assembly and power divider can be removed from the axle housing as a unit.

Follow the sections of this manual that cover individual service needs.

Safety glasses should be worn at all times when assembling or disassembling axles.

SAFTEY PRECAUTIONS

Proper service and repair of vehicle components is important to the safe and reliable operation of all motor vehicles. This applies particularly to driving axles such as the ones described in this manual. The procedures recommended and described in this manual are tested, and effective methods for performing service operations. Follow each procedure closely, making use of both the text and illustrations. Some of these service procedures show the use of certain tools designed specifically for the operation being performed. They are shown as a preferred means of performing the operation. It is not practical to anticipate and advise the service trade of all possible alternative methods, and of all possible hazardous consequences that could result from any particular method.

Accordingly, anyone who uses a service procedure or tool different than shown must first thoroughly satisfy themselves that their safety, nor the vehicle safety, will be jeopardized by the service method selected.

END YOKES AND FLANGES

⚠ **CAUTION: Hammering on end yokes could damage the bearing bores or misalign yoke lugs and result in early failures of journal needle bearings or other driveline components. Serious damage can also be done internally to the ring and pinion set or pinion bearings by hammering on external parts. End yokes or companion flanges should be removed or installed using the recommended method such as that described herein.**

CLEANLINESS

Axle components should be steam cleaned prior to removal from the vehicle. Dirt is abrasive and can cause premature wear of otherwise serviceable parts. Service personnel should use a wash tank for thorough cleaning of parts just prior to reassembly.

⚠ CAUTION

BRAKE LININGS CONTAIN NON-ASBESTOS FIBERS

BREATHING BRAKE DUST MAY BE HAZARDOUS TO YOUR HEALTH AND MAY CAUSE SERIOUS RESPITORY OR OTHER BODILY HARM.

AVOID CREATING DUST

DO NOT REMOVE BRAKE DRUM WITHOUT PROPER PROTECTIVE EQUIPMENT.

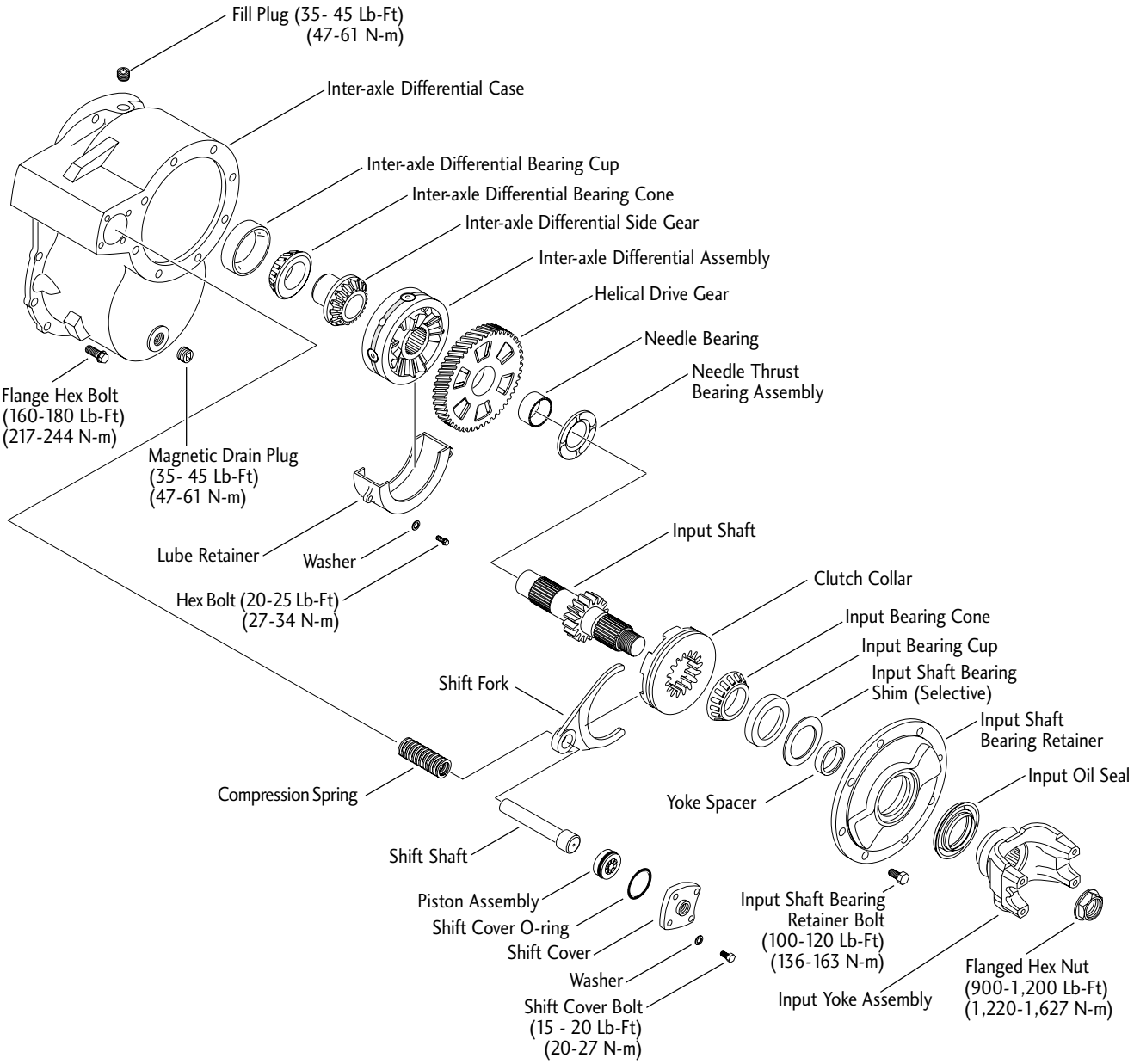
DO NOT WORK ON LININGS WITHOUT PROPER PROTECTIVE EQUIPMENT.

DO NOT REPLACE LININGS WITHOUT PROPER PROTECTIVE EQUIPMENT.

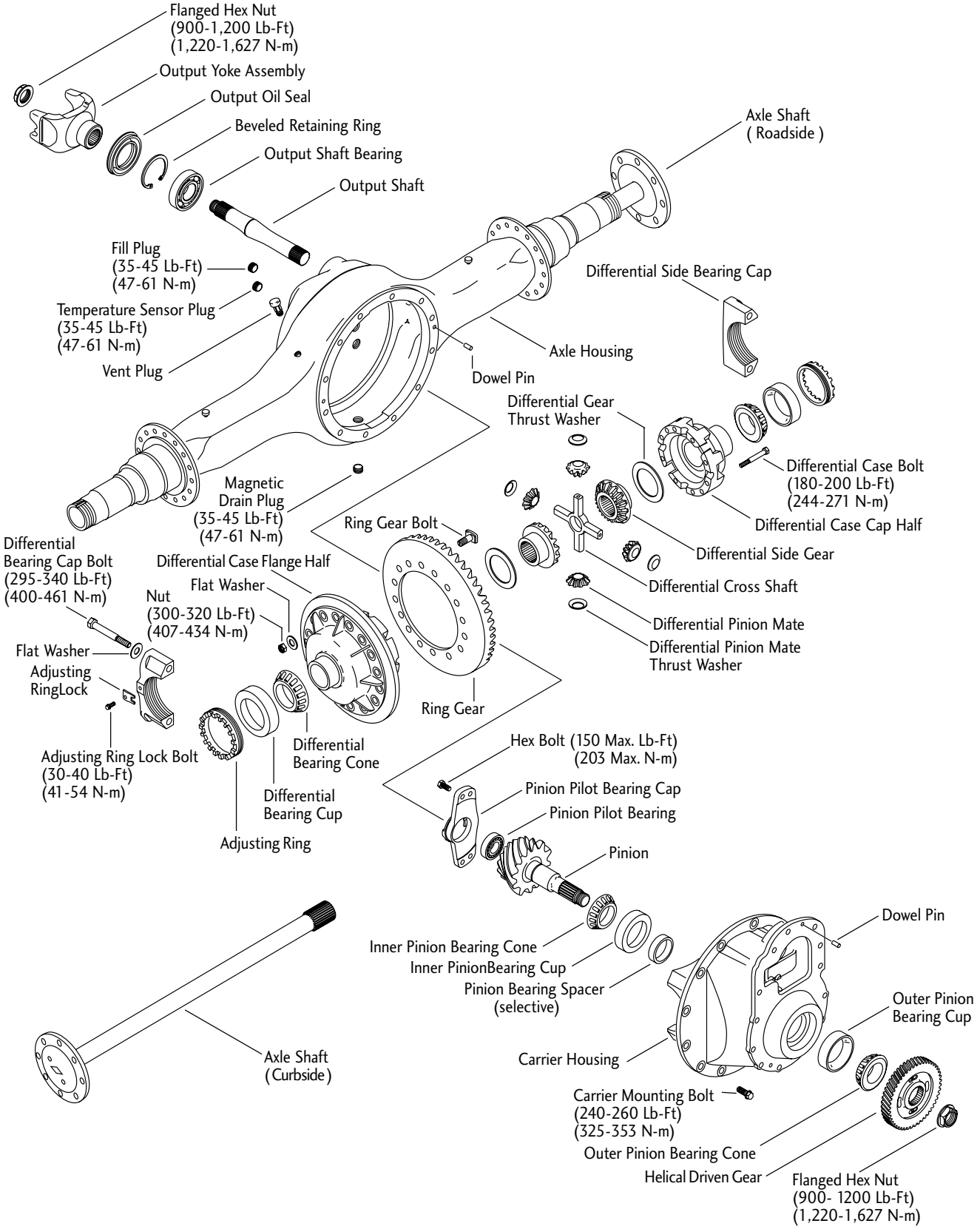
DO NOT ATTEMPT TO SAND, GRIND, CHISEL, FILE, HAMMER OR ALTER BRAKE LININGS IN ANY MANNER WITHOUT PROPER PROTECTIVE EQUIPMENT.

FOLLOW 0.S.H.A. STANDARDS FOR PROPER PROTECTIVE DEVICES TO BE USED WHEN WORKING WITH BRAKE MATERIALS.

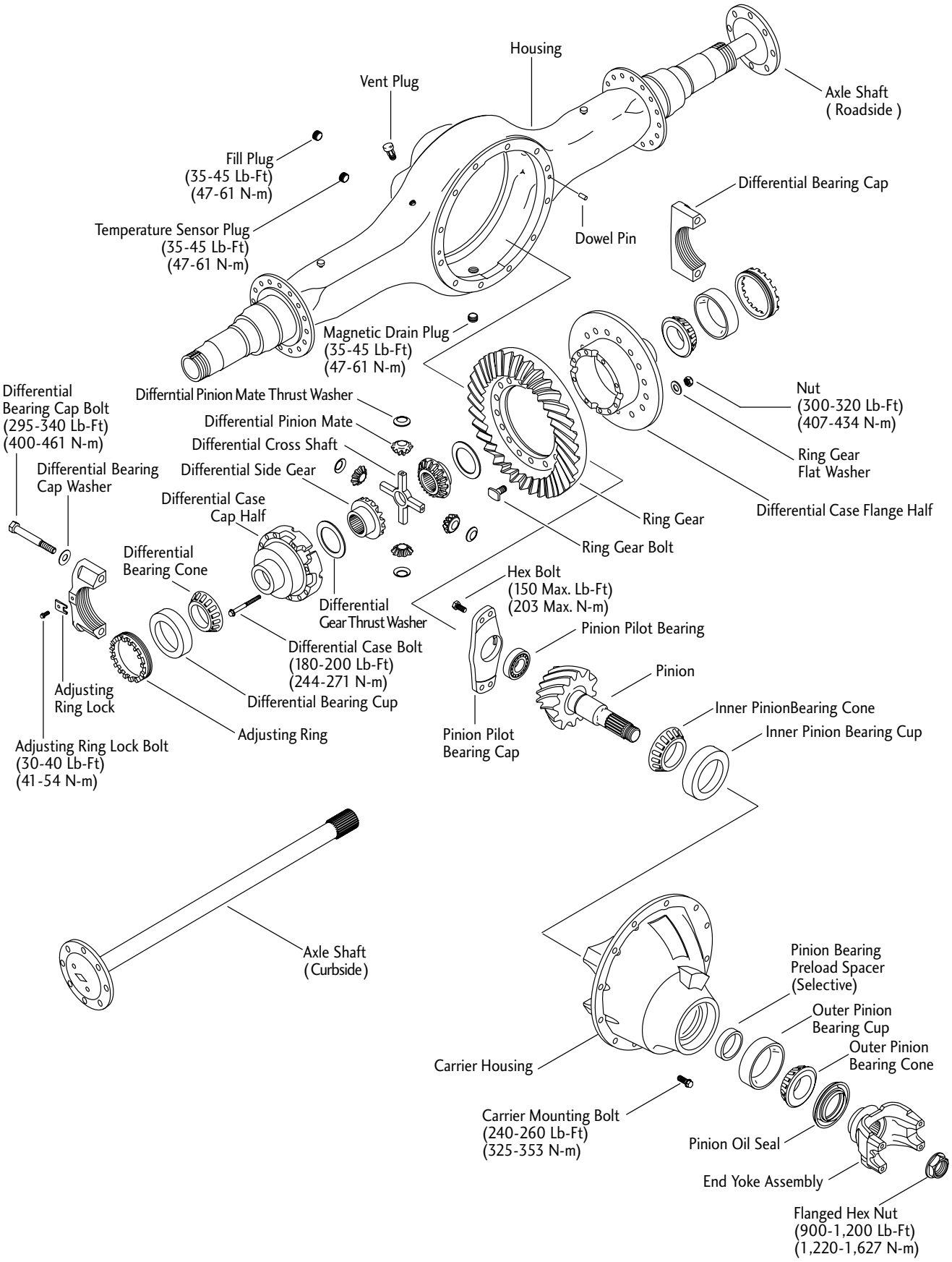
POWER DIVIDER COMPONENTS



FORWARD REAR COMPONENTS



REAR REAR COMPONENTS



REMOVAL OF DIFFERENTIAL CARRIERS FROM AXLE HOUSINGS

NOTE: Steam clean axle assembly.

1. Block wheels.
2. Remove axle housing and power divider drain plugs and drain lubricant.
3. Disconnect drive shaft at the rear U-joint.

NOTE: If end yoke and/or seal is to be replaced, loosen yoke nut at this time.

4. Match mark each axle shaft flange to its mating wheel end and remove axle shaft flange nuts.

IMPORTANT: Axle shafts are of different lengths and should be marked accordingly for proper reassembly.

5. Hold a large brass drift or a brass hammer against the center of the axle shaft flange. Strike the drift with sharp blows from a large hammer or sledge until the axle shaft separates from the hub.

⚠ CAUTION: Do not strike the flange directly with a steel hammer or sledge. This may crack and splinter material, possibly causing serious or fatal injury. Do not pry or chisel axle flange away from hub or damage to sealing surfaces could occur.

6. Remove axle shafts. **Remember due to different length axle shafts, each shaft should be marked to mating wheel end for proper reassembly.**
7. Disconnect air line from power divider shift cover on forward rear assembly.
8. Support the differential carrier assembly on a roller jack. Secure as necessary to prevent it from falling off the jack when removed from the housing.
9. Loosen the differential carrier-to-housing mounting bolts. Remove all bolts except top two. These two bolts will prevent the carrier assembly from falling.

IMPORTANT: Thread two guide pins into axle housing to relieve weight from output shaft bearing assembly of forward rear during differential carrier removal.

10. Separate differential carrier from the housing using removal slots. **See Figures 1** and 2. Be certain differential carrier clears dowel pins and is balanced properly on jack. Remove top two carrier mounting bolts, and remove differential carrier assembly from the axle housing.

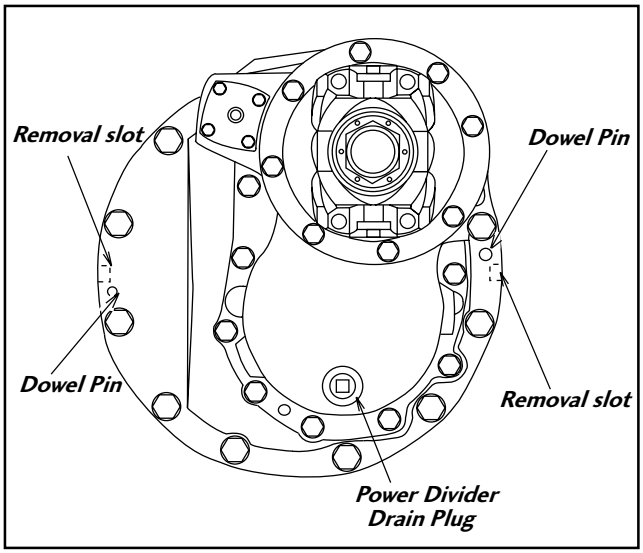


Figure 1

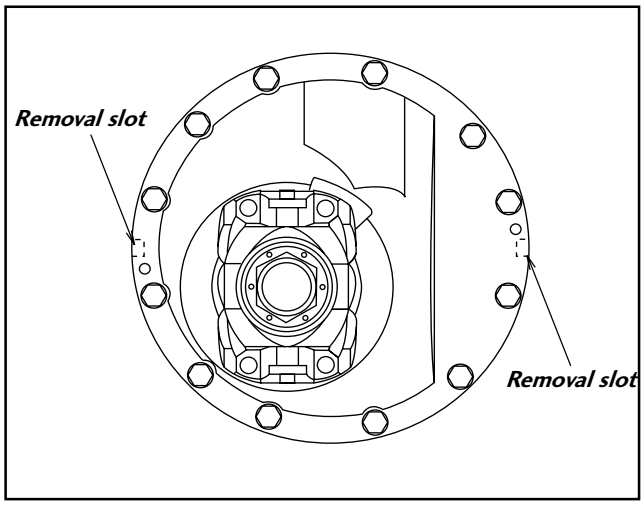


Figure 2

11. Mount carrier assembly in a suitable rebuild stand. (Refer to **RECOMMENDED SERVICE TOOLS**, pgs. 29-30)

Differential Carrier Removal Complete

REMOVAL OF DIFFERENTIAL FROM CARRIER

The following service procedures apply for both forward rear and rear rear axles, unless otherwise noted.

IMPORTANT: If the ring and pinion is to be reused, ring gear backlash should be checked and recorded before disassembly. Backlash should be reset to this specification after completion of repairs. For backlash specifications refer to DIFFERENTIAL INSTALLATION.

1. Remove adjusting ring bolts and locks from bearing caps.
2. One differential bearing cap and leg of the carrier is match marked to aid during reassembly. See Figure 3.
3. Loosen four bearing cap retaining bolts.
4. Loosen adjusting rings, to relieve bearing preload.
5. Remove four bearing cap retaining bolts and washers.
6. Remove bearing caps.
7. Remove adjusting rings and bearing cups.

NOTE: If bearings are to be reused, cups must stay with mated cones. They can not be interchanged.

8. Carefully lift the ring gear and differential subassembly out of carrier.

NOTE: The ring gear side of subassembly must be tipped up for the ring gear to clear the pinion pilot bearing cap.

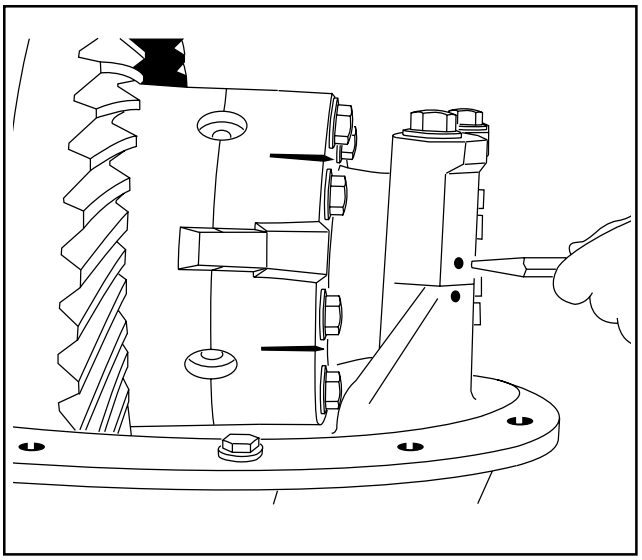
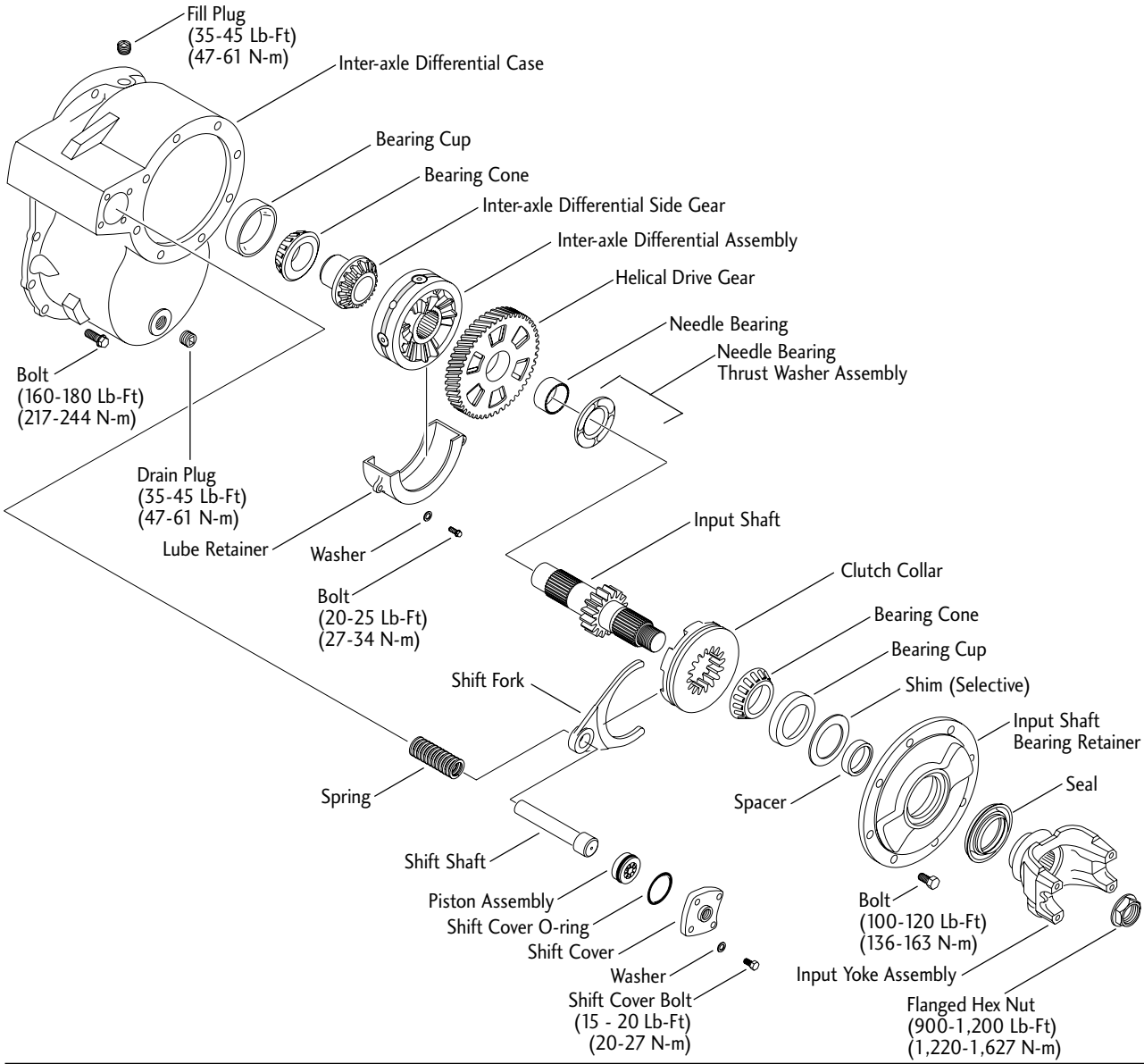


Figure 3

Removal of Differential Complete

INTER-AXLE DIFFERENTIAL DISASSEMBLY



1. Remove intermediate case to carrier bolts. Use removal slots to seperate inter-axle differential case from carrier. See Figure 4.
2. With inter-axle differential assembly removed, remove four bolts and washers of shift cylinder.
3. Remove shift cylinder cap and piston.

NOTE: It may be necessary to tap piston lightly with soft mallet to remove.

4. Remove shift cylinder shaft.
5. Remove flanged hex nut.

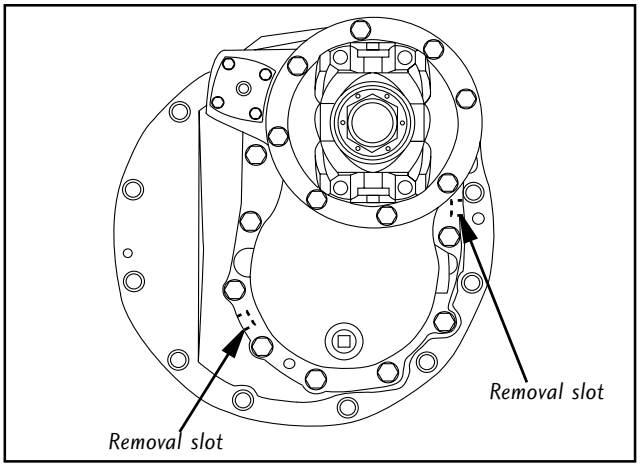


Figure 4

NOTE: Use of a torque multiplier is recommended as torque specification on input flanged hex nut is 900-1,200 Lb-Ft (1,220-1,627 N-m). (Refer to RECOMMENDED SERVICE TOOLS, pgs. 29-30)

6. Remove input yoke using a suitable puller. See Figure 5.

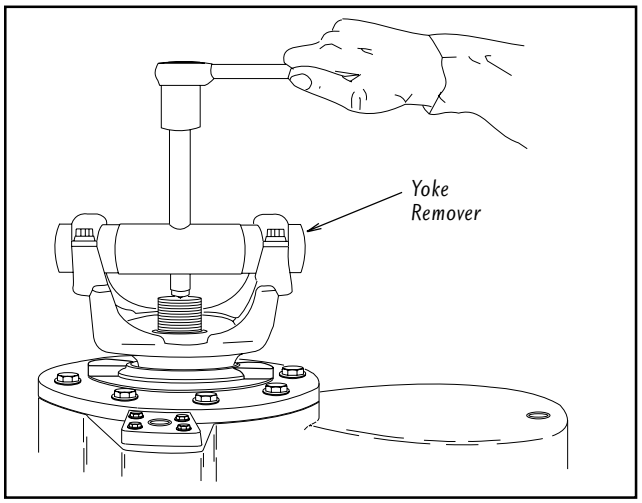


Figure 5

7. Remove bolts from input shaft bearing retainer. Use removal slots (See Figure 6) to seperate bearing retainer from inter-axle differential case, and remove retainer.

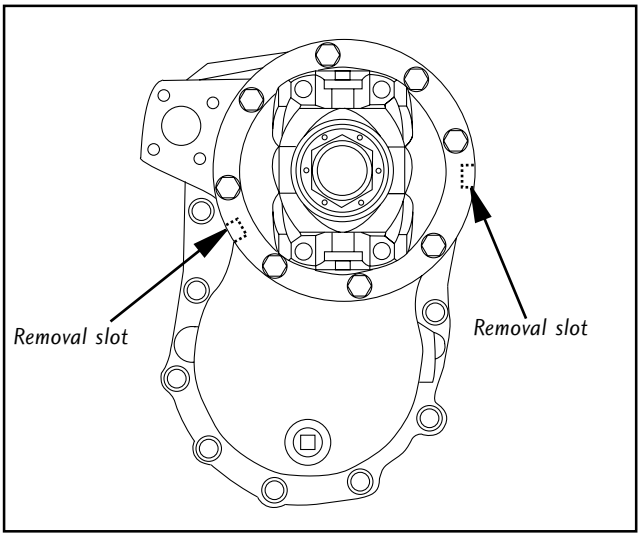
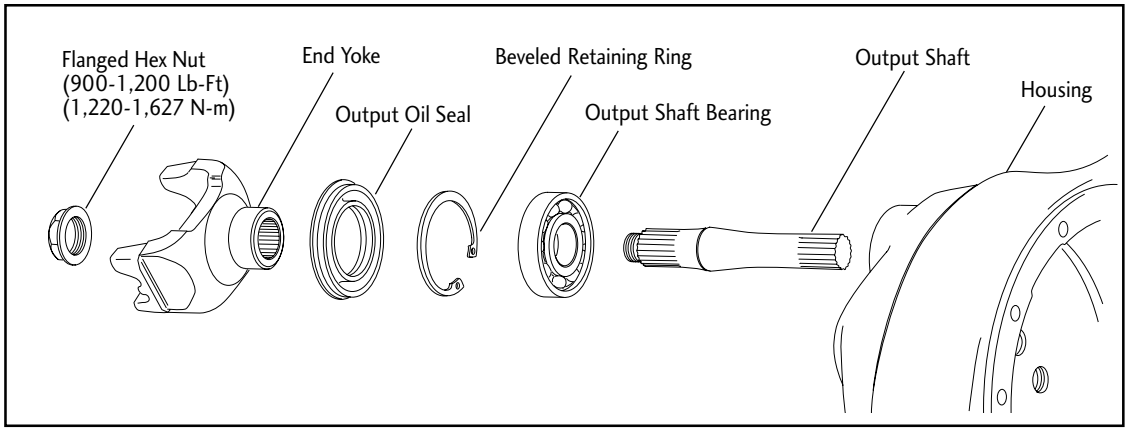


Figure 6

8. Remove input oil seal
9. Press out input shaft bearing cup from bearing retainer. Retain shims for possible use during reassembly. Early models were not a press fit.
10. Remove input shaft assembly. Remove input yoke spacer from input shaft.
11. Remove front bearing cone from input shaft using suitable puller.
12. Remove clutch collar, shift fork, and spring from assembly.
13. Remove needle thrust bearing assembly from top of drive gear.
14. Remove drive gear from inter-axle differential case.
15. Remove two lube retainer bolts.
16. Remove lube retainer.
17. Remove inter-axle differential assembly from case.
18. Remove rear Diff-gear from inter-axle differential case.
19. Remove rear bearing cup from intermediate case.
20. Remove bearing cone from rear differential gearusing a suitable puller.
21. Clean and inspect all components for excessive wear, scoring, or cracks. Replace damaged components with original equipment replacement parts and prepare for reassembly.

Inter-Axle Differential Disassembly Complete

OUTPUT SHAFT DISASSEMBLY



1. Remove the inter-axle drive shaft.

NOTE: Power divider must be engaged so shaft will not rotate.

2. Remove output flanged hex nut.

NOTE: Use of torque multiplier is recommended as torque specification on output nut is 900-1,200 Lb-Ft (1,220-1,627 N-m).

3. Remove output yoke using a suitable puller.
4. Remove oil seal.
5. Remove beveled retaining ring.
6. Place output shaft remover adapter into housing bore.
7. Thread yoke installer service tool onto output shaft. See Figure 7.
8. Tighten nut on yoke installer to pull output shaft bearing assembly out of housing.
9. If output shaft bearing is to be replaced, remove old bearing using a suitable puller or press.

NOTE: It is important to place the Output Shaft Remover Adapter on with the shoulder to the outside. See Figure 7.

Output Shaft Removal Complete

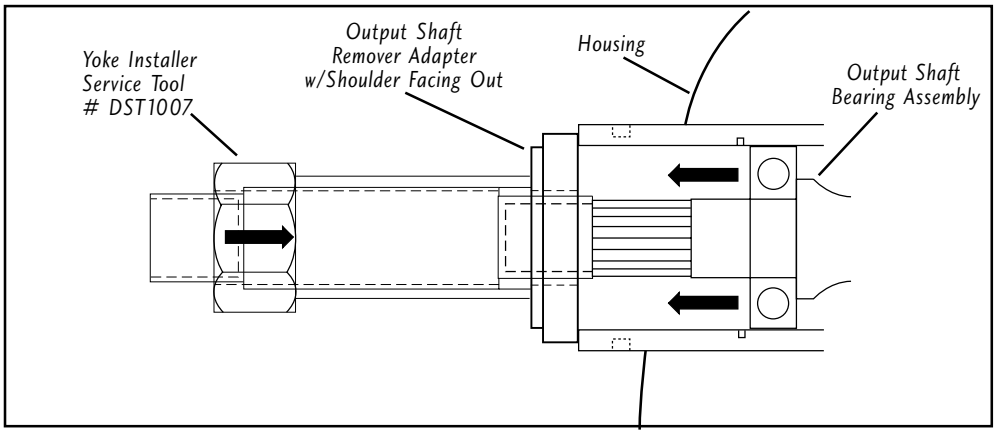
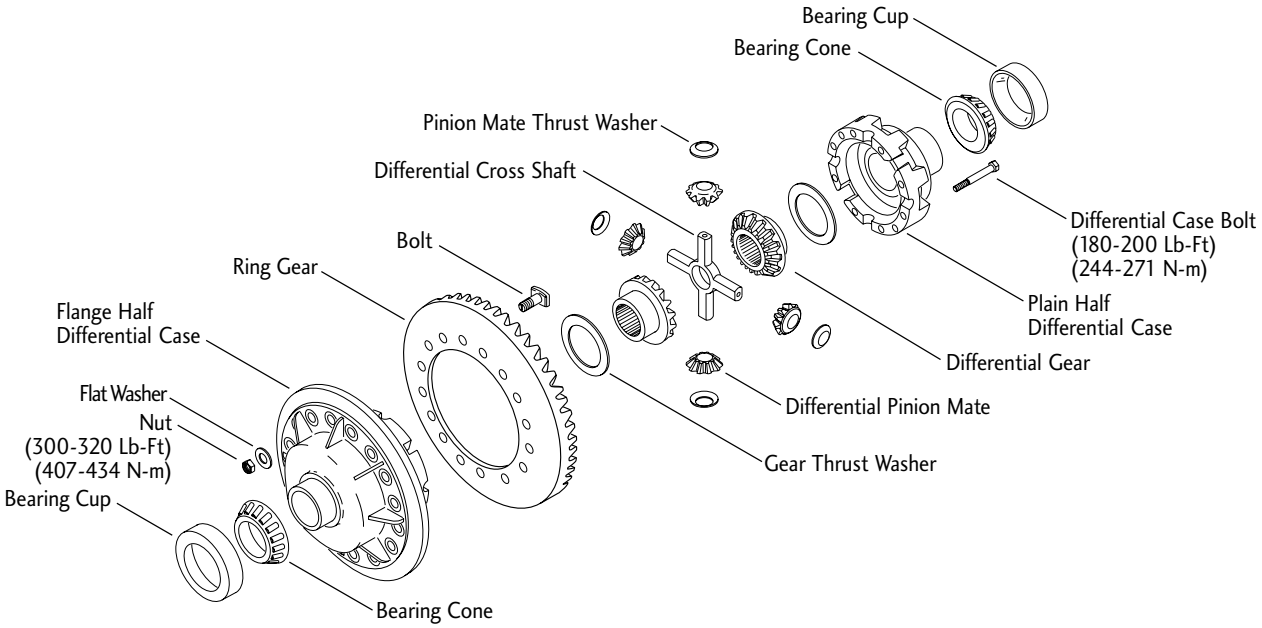


Figure 7



1. Match mark differential case halves with a punch or chisel for correct alignment in reassembly. See Figure 8.

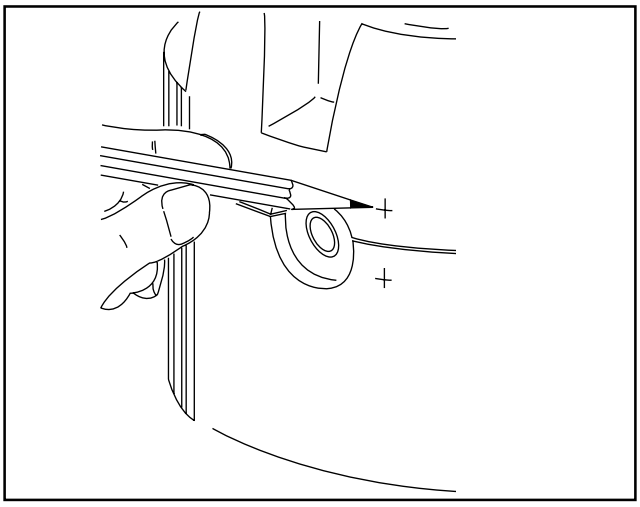


Figure 8

2. Remove differential case bolts and lift off the differential case half.
3. Remove thrust washer and differential gear.
4. Lift out cross shaft, pinion mates and pinion mate thrust washers.
5. Remove second differential gear and thrust washer.
6. If differential bearings are to be replaced, remove old bearings using a suitable puller. See Figure 9.

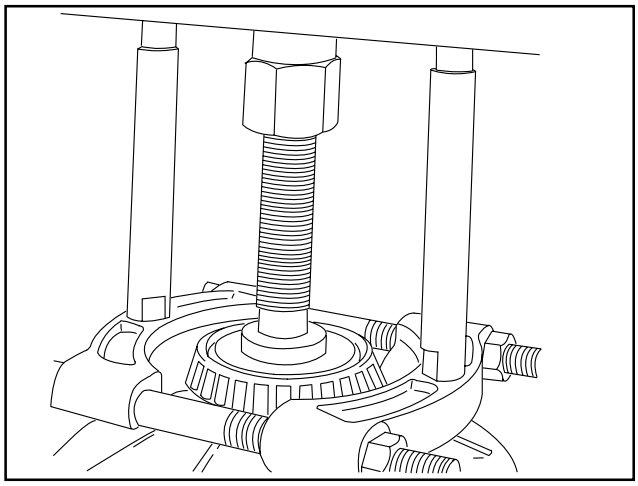


Figure 9

NOTE: Inspect all parts including the machined surfaces of the case itself.

IMPORTANT: If any gears are to be replaced, they must be replaced in sets. Inspect thrust washers for scoring and excessive wear. Replace all worn or damaged parts.

7. When it is necessary to remove ring gear from differential case, carefully loosen ring gear nuts with breaker bar in an alternating pattern and remove.

IMPORTANT: Do not damage ring gear when loosening ring gear nuts.

8. Inspect ring gear, ring gear bolts, and ring gear bolt holes for nicks, excessive wear, and irregularities.

PINION DISASSEMBLY

1. Remove flanged hex nut.

NOTE: Use of a torque multiplier is recommended. Torque flanged hex nut to 900-1,200 Lb-Ft (1,220-1,627 N-m).

2. Remove end yoke on the rear rear axle using a suitable puller. Refer to RECOMMENDED SERVICE TOOLS, pgs. 29-30).
3. Remove the oil seal on the rear rear axle and discard.
4. Remove the four pinion pilot bearing support bolts.
5. Remove the pinion pilot bearing support.
6. Place carrier in press with threaded end of pinion face up. See Figure 10 and 10A.
7. Place a wooden block under pinion to avoid damage of gear teeth during removal.
8. Pinion removal -
   - On the Forward Rear, press the pinion through the helical driven gear and inner and outer bearing cones. See Figure 10.
   - On the Rear Rear, press the pinion through the inner and outer bearing cones. See Figure 10A.
9. Remove the pinion from the bottom of the carrier.
10. Remove bearing preload spacer and save for use in reassembly.
11. If the gearset is to be reused, remove inner pinion bearing with a suitable puller at this time. If the gear set is to be replaced new bearings must be installed.
12. If bearings are to be replaced, press bearing cups out of carrier casting at this time.
13. Remove pinion pilot bearing with a suitable puller.

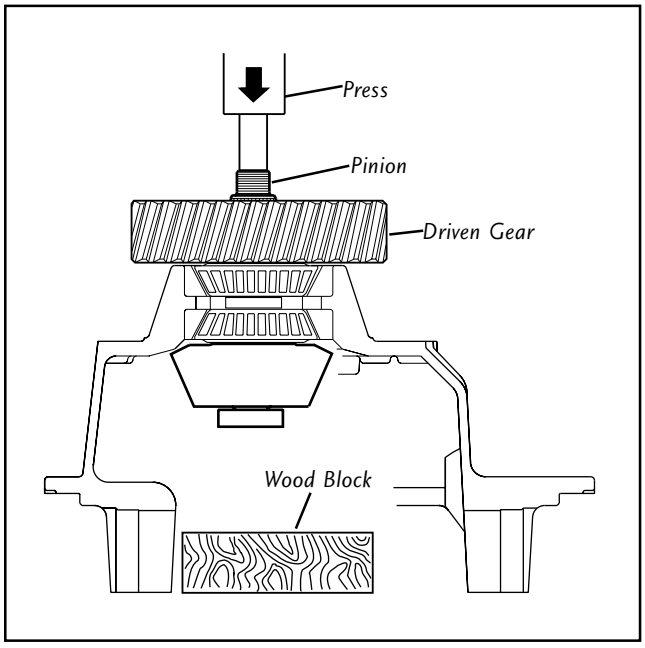


Figure 10

Pinion Disassembly Complete

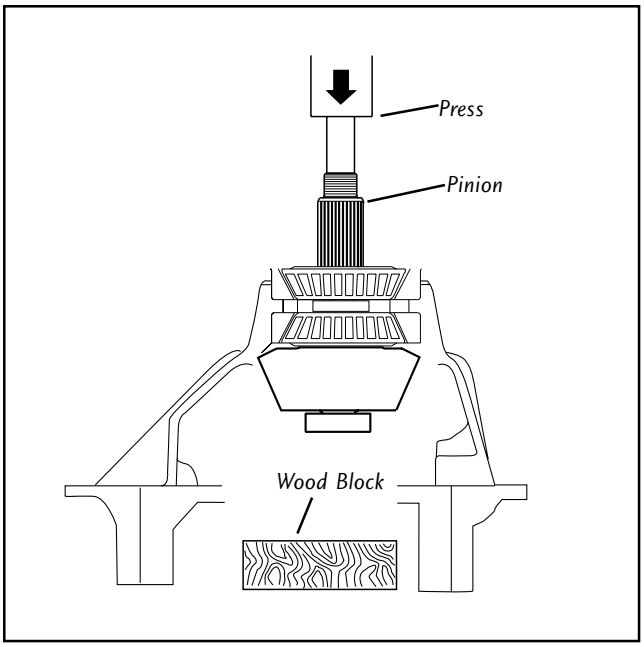


Figure 10A

CLEANING

1. Parts should be cleaned with emulsion cleaners or petroleum base cleaning solvent.

NOTE: Alkaline type solutions may cause damage to machined surfaces and should be avoided.

2. Make sure interior of axle housing is clean prior to reassembly.
3. Clean all gasket surfaces of old material.

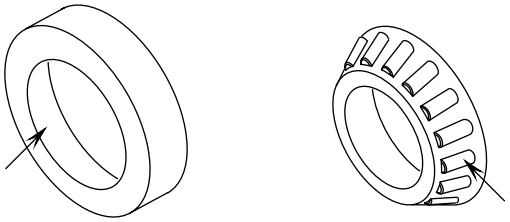
DRYING

Use soft, clean, lintless towels or rags to dry components after cleaning. Bearings should *not* be dried by spinning with compressed air. This can damage mating surfaces due to the lack of lubrication.

After drying, parts should be coated with a light coat of lubricant or rust inhibitor to prevent damage from corrosion. If parts are to be stored for a prolonged period, they should be wrapped in wax paper.

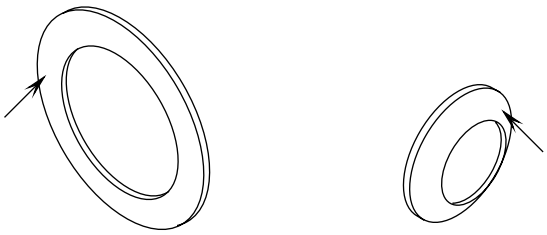
INSPECTION

Prior to reassembly, inspect parts for signs of excessive wear or damage. Replacement of these parts can prevent premature failure and costly downtime.



BEARINGS

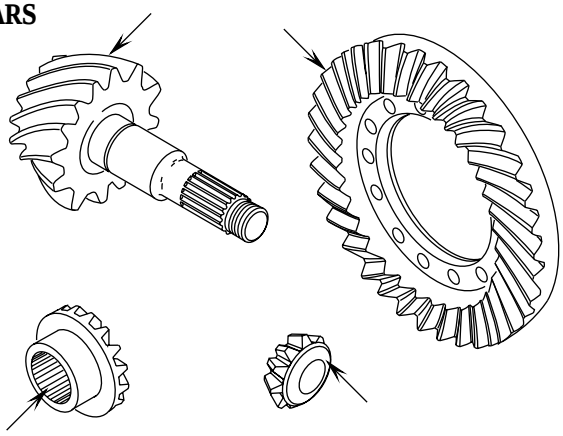
Bearing surfaces should be inspected for pitting, excessive wear, or overheating.



THRUST WASHERS

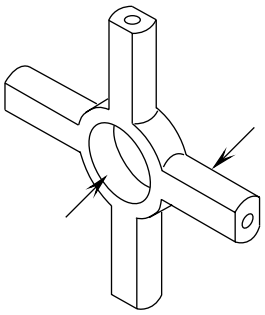
Inspect thrust washers for scoring and cracking.

GEARS



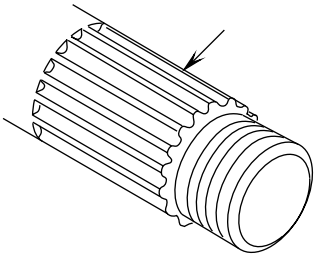
Inspect gears for excessive wear or damage. Replace gears that are pitted, scored, broken, or worn.

SHAFTS



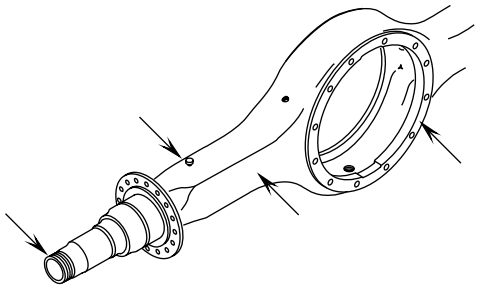
Inspect shafts for nicks or scoring.

SPLINES



Inspect all splines for excessive wear, distortion from twisting, and cracking.

HOUSINGS



Inspect housing for stripped threads and bending fatigue.

PINION ASSEMBLY

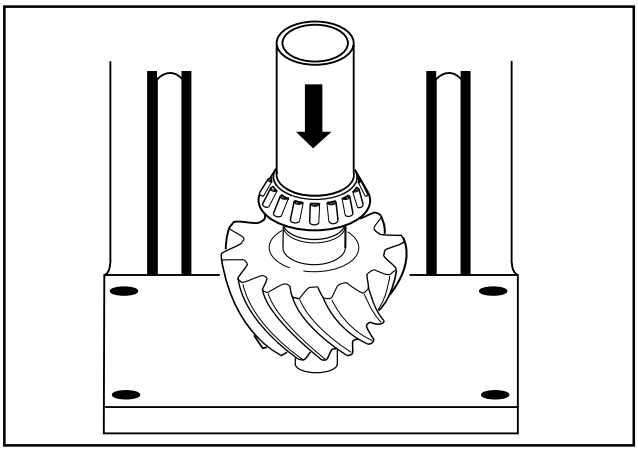


Figure 11

1. Press inner bearing cone onto pinion. See Figure 11.
2. Press pinion pilot bearing onto the pinion. See Figure 12.

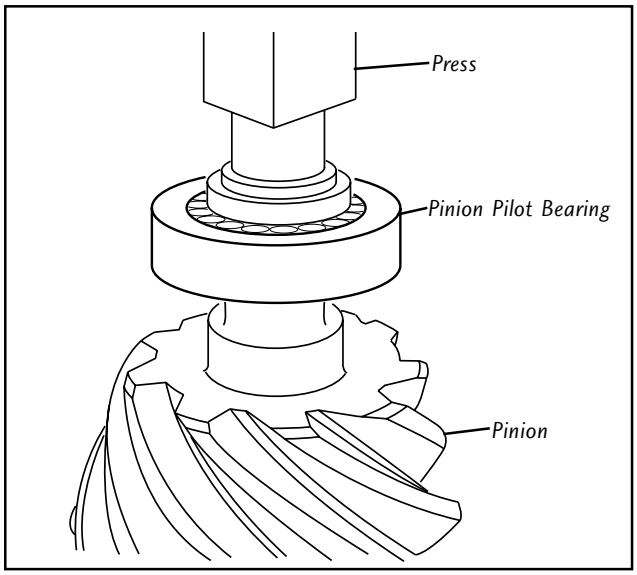


Figure 12

NOTE: Chamfer side of bearing faces the pinion head.

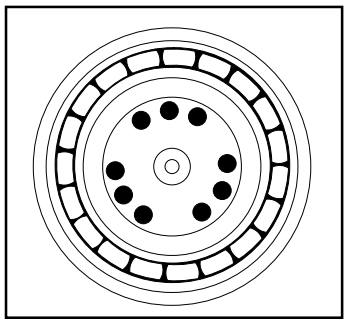


Figure 13

NOTE: Alkaline type solutions may cause damage to machined surfaces and should be avoided.

3. Stake pilot bearing in nine places using a center punch or equivalent tool. See Figure 13.
4. Press inner and outer bearing cups into the carrier until seated. Use a feeler gauge (.0015 inch) to make sure that bearing cups are fully seated in bearing bores. Apply hypoid gear lubricant to both cup and cone. See Figure 14.

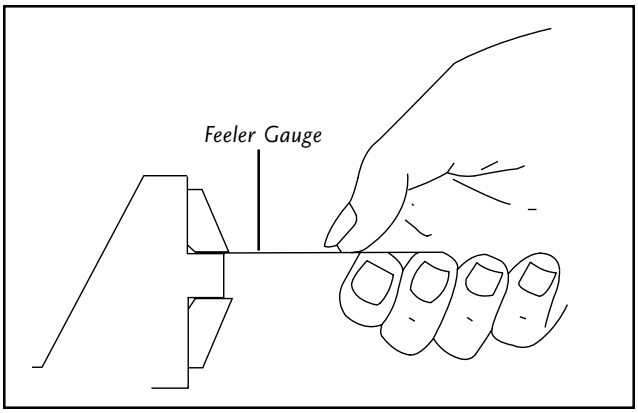


Figure 14

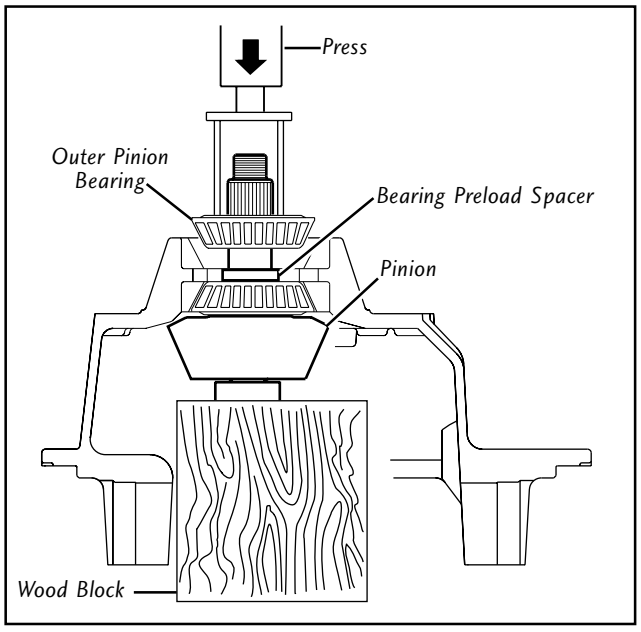


Figure 15

NOTE: After installing pinion bearing and or helical gear, pinion shaft should be turned at least 8 rotations to assure proper alignment of bearing rollers.

5. Place carrier housing in press with the pinion supported by wood block (6"X6"X6"), so the inner pinion bearing is mated to the cup. See Figure 15.
6. Insert original preload spacer and outer pinion bearing onto pinion.
7. Press outer pinion bearing onto pinion until completely seated.
8. On forward rear, press driven gear onto pinion. See Figure 16.

IMPORTANT: The old style driven gear on the 3.21 and 3.42 ratios will have "FRONT" stamped on the face of the gear. This gear must be installed with the word "FRONT" facing away from the carrier assembly. If you do not have this driven gear no special instructions apply to the installation of the gear.

9. On rear rear carrier, inspect end yoke or companion flange, for grooves in seal surface. If grooves can be

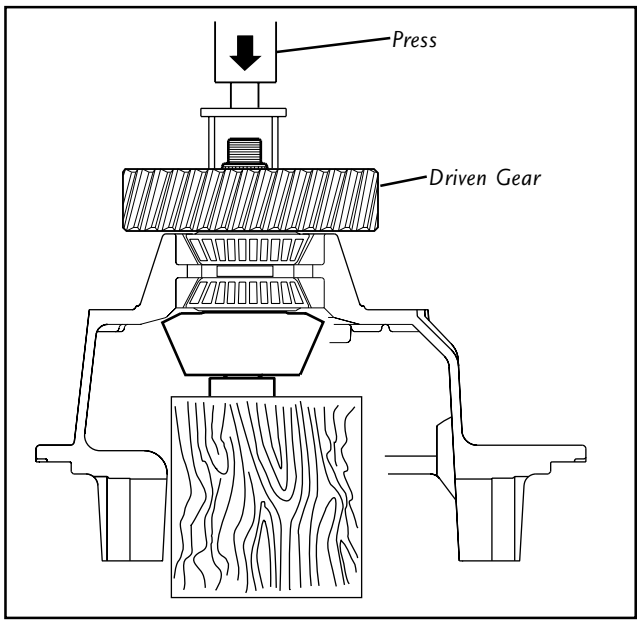


Figure 16

detected with finger-nail, then end yoke must be repaired with a C/R approved repair sleeve or replaced.

10. Use yoke installer service tool and install yoke without seal. See Figure 17.
11. Use torque multiplier and torque flanged hex nut to

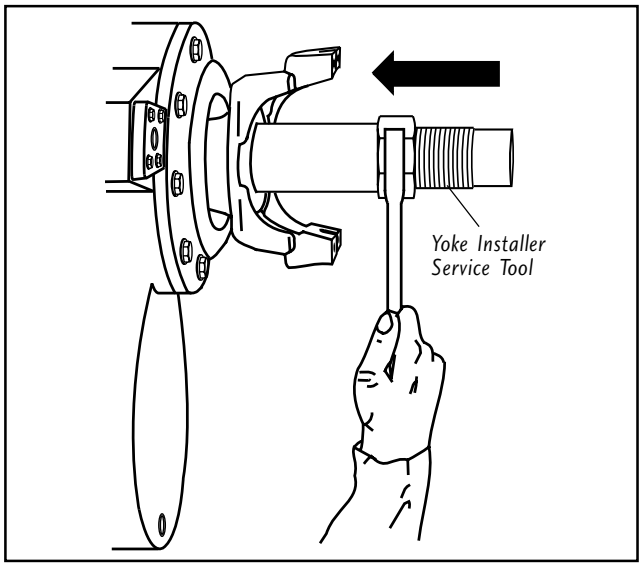


Figure 17

900-1,200 Lb-Ft (1,220-1,627 N-m).

12. Install pinion pilot bearing cap. Tighten and torque four bolts to 150 Lb-Ft (203 N-m).
13. Measure torque to rotate with an inch-pound torque wrench. Make eight revolutions, taking a torque measurement every fourth revolution. It should read between 10-40 lb-in of bearing preload. See Figure 18.

NOTE: If bearing preload does not fall within allowed limits, preload can be increased by using a thinner spacer and decreased by using a thicker spacer.

.001 inch change in preload spacer will change torque to rotate approximately 30 lb-in.

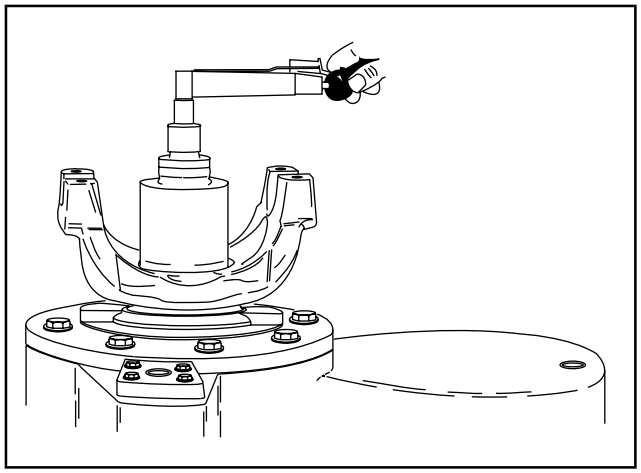


Figure 18

PINION ASSEMBLY

NOTE: Individual carriers may vary slighty.

Pinion bearing preload spacers are available in the following thicknesses:

inch	mm	inch	mm
.718	18.24	.731	18.57
.719	18.26	.732	18.60
.720	18.29	.733	18.62
.721	18.31	.734	18.64
.722	18.34	.735	18.67
.723	18.36	.736	18.69
.724	18.39	.737	18.72
.725	18.41	.738	18.75
.726	18.44	.739	18.77
.727	18.47	.740	18.80
.728	18.49	.741	18.82
.729	18.52	.742	18.85
.730	18.54		

Always measure each spacer before assembly to ensure correct thickness.

NOTE: Closer adjustment can be made by sanding the next thicker spacer to desired thickness using emery cloth on a flat surface.

CAUTION: Wash spacer thoroughly of emery cuttings before installing on pinion.

14. Repeat process until torque to rotate is between 10-40 lb-in after preload is achieved, remove yoke and install new seal with proper service tool.

NOTE: Acceptable torque to rotate with seal installed is 15-45 lb-in.

15. Install yoke using yoke installer (See RECOMMENDED SERVICE TOOLS, pgs. 29-30)

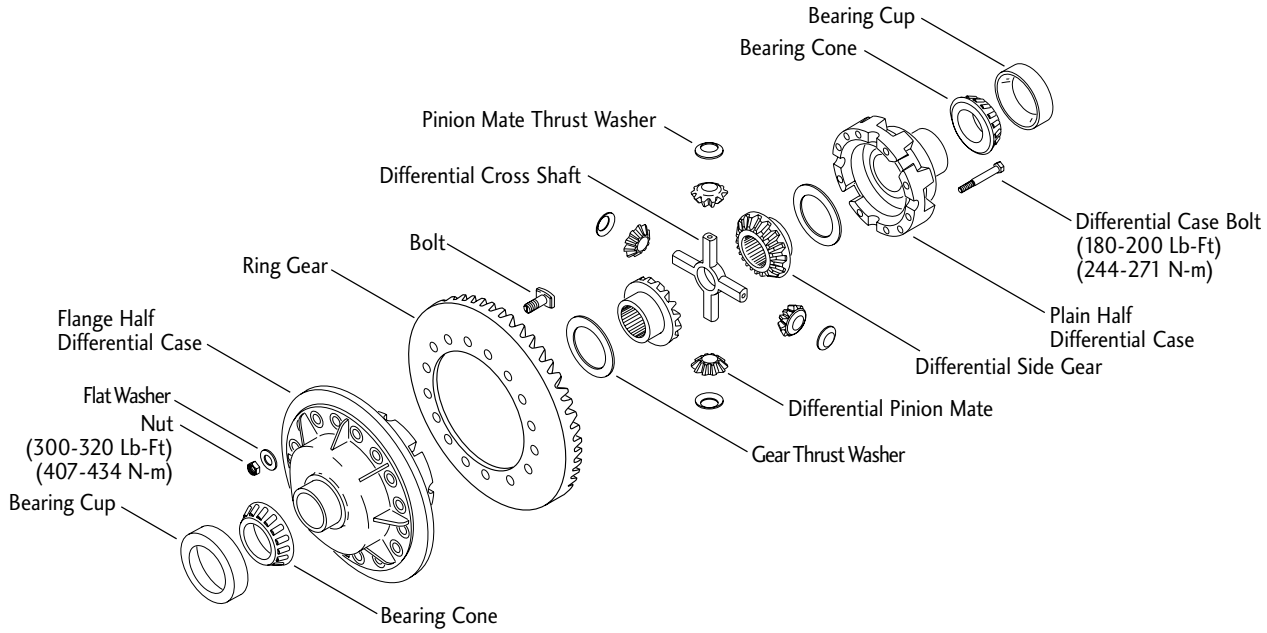
NOTE: Spicer recommends that new flanged hex nuts be used.

16. Apply Loctite #680 (green) to threads.

17. Use torque multiplier and torque flanged hex nut to 900-1,200 Lb-ft (1,220-1,627 N-m).

Pinion Assembly Complete

DIFFERENTIAL ASSEMBLY



1. If ring gear was removed from the differential case, reinstall it at this time.
   - Clean the differential case and ring gear mounting surface.
   - Position the differential case on a work bench with the machine surface down.
   - Place the ring gear on the case with the teeth facing up.
   - Install bolts into the tooth side of the ring gear and install the flat washer and nut onto the differential case side.

NOTE: Bolts have a clearance fit in the differential case and the ring gear mounting holes. Bolts require correct torque to ensure proper clamp.

- When all bolts have been installed, tighten opposite one another until one half the prescribed torque is obtained. 150-160 Lb-Ft (204-217N-m)

NOTE: Bolt heads must be held flat against ring gear while torque is being applied.

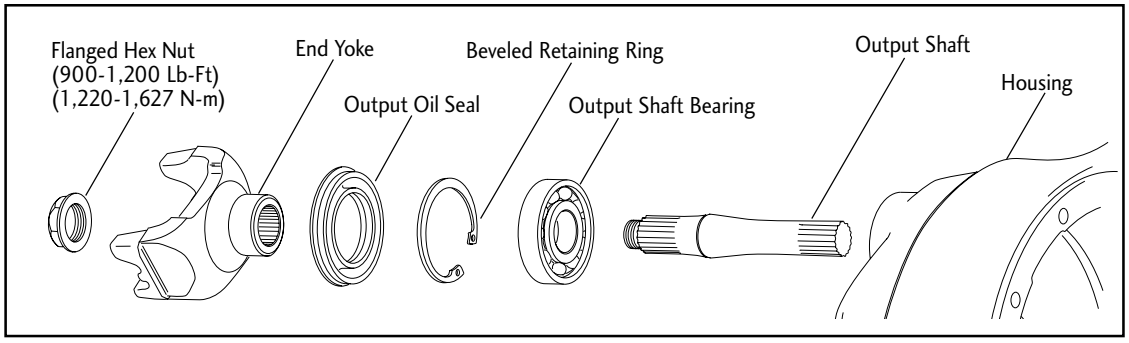
- Repeat the process to full torque specifications. 300-320 Lb-Ft (407-434 N-m)

2. Press bearing cones onto differential case halves. Place bearing cups on cones during remainder of assembly to prevent damage of bearings.
3. Apply a small amount of hypoid axle lubricant to all mating surfaces. This will aid in assembly by keeping parts together and providing initial lubrication.
4. Place gear thrust washer and differential side gear in differential case flange half.
5. Assemble pinion mates and pinion mate thrust washers onto differential cross shaft. Place assembly into flange half differential case.
6. Place remaining differential side gear and thrust washer in position on differential pinion mates.
7. Assemble case halves, making sure match marks are lined up.
8. Install differential case bolts. Tighten alternately and torque evenly to 180-200 Lb-Ft (244-27N-m).

NOTE: If old bolts are used, coat threads with Loctite #277 before installing.

Differential Assembly Complete

OUTPUT SHAFT ASSEMBLY



1. Press new bearing onto shaft using output shaft bearing installer service tool. See Figure 19.

NOTE: Clean bore of housing to remove old Loctite and oil.

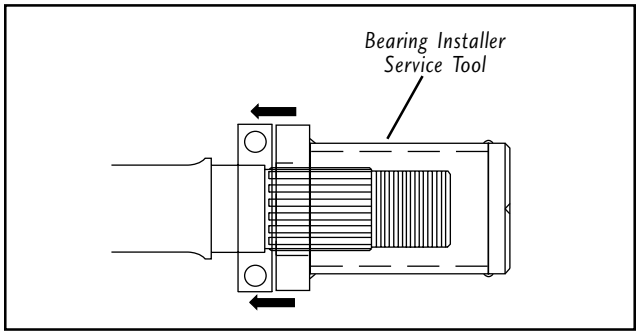


Figure 19

2. Apply a thin layer of Loctite #620 to the outside diameter of the bearing before assembly into housing.

NOTE: Care must be taken to keep Loctite out of bearing.

3. Install output shaft and bearing assembly into housing using bearing installer service tool withadequate 2 jaw puller. See Figure 20.
4. Seat bearing completely in housing and remove excess Loctite.
5. Install beveled retaining ring in housing with bevel facing to the rear of the axle. Be certain the retainer ring is fully seated. Clean and dry threads on output shaft.
6. Lubricate bearing with hypoid axle lube.
7. Install oil seal using proper service tools.
8. Install end yoke using yoke installer service tool.
9. Apply Loctite #680 to threads before installing new flanged hex nut.
10. Use torque multiplier and torque flanged hex nut to 900-1,200 Lb-Ft (1,220-1,627 N-m).

Output Shaft Installation Complete

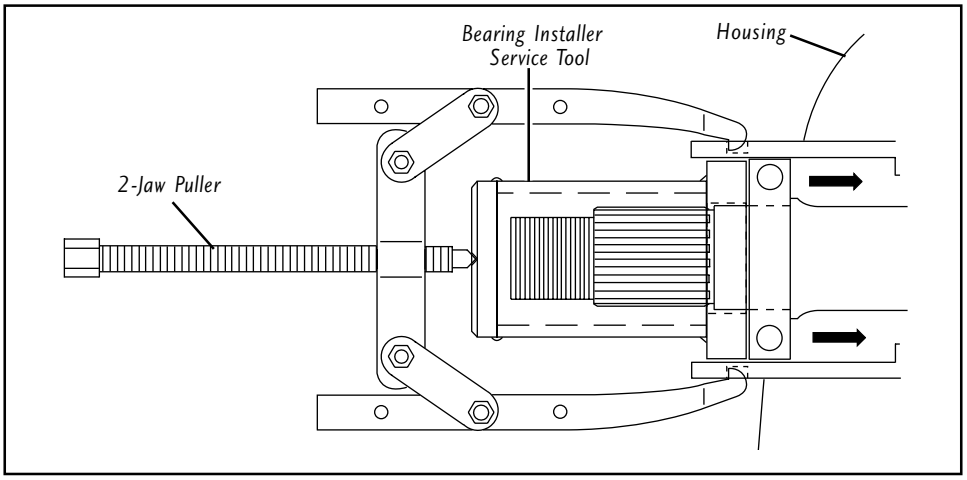


Figure 20

1. Position inter-axle differential case on two 4" x 4" blocks for reassembly
2. Install new rear differential bearing cup into case.
3. Press new bearing cone onto rear differential gear.

NOTE: Be certain that both cup and cone are seated properly or false reading on end play of inter-axle may occur.

4. Apply a light coating of gear lube to rear diff-gear bearing, hub surface, and interior bore, then install..
5. Lubricate and place inter-axle differential assembly inside of plastic lube retainer and install into case.
6. Align the bolt holes of the plastic lube retainer with the case and install the two bolts and washers. Tighten and torque lube retainer bolts to 20-25 Lb-Ft (27-34 N-m).
7. Press new needle bearing into I.D. of drive gear.
8. Lubricate needle bearing and carefully lower drive gear into intermediate case until differential gear is seated in inter-axle differential.
9. Press input shaft front bearing cone onto shaft until seated completely against shoulder.
10. Lube the needle thrust bearing lightly and place on front drive gear. Ensure that thin bearing race is seated against drive gear and the thrust bearing is seated between the two spacers.

NOTE: To establish proper end play, input shaft will be installed into inter-axle differential prior to installing shift collar, fork , and shift shaft.

11. Lube and install input shaft, turning slightly to engage splines.
12. Install new input shaft front bearing cup into input shaft bearing retainer without shims.
13. Install bearing retainer onto intermediate housing and bolt into place.
14. Thread input flanged hex nut onto input shaft until resistance is felt from locking compound.

    Tap nut lightly with soft hammer.

15. Position dial indicator onto end of input shaft. See Figure 21.

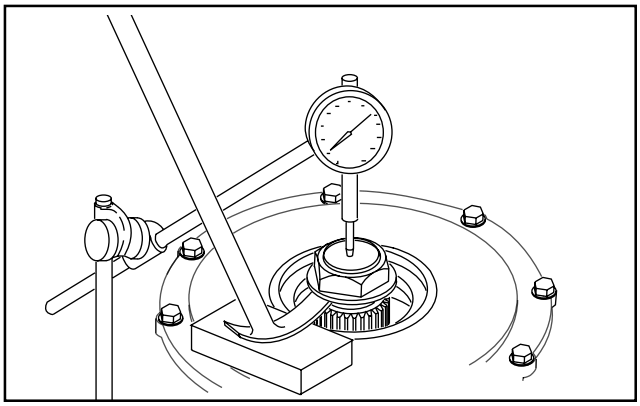


Figure 21

    Using suitable pry bar and spacer, pry input shaft out and record end play.

16. Proper end play for inter-axle is .001 to .003 inch (.025 to .076 mm). Subtract .003 inch (.076 mm) from recorded end play and assemble combination of shims that total proper thickness to establish correct end play.

EXAMPLE:

Measurement with dial indicator.	.080in. (2.032 mm)
Preferred end play.	−.003in. (0.076 mm)
Required shims.	.077in. (1.956 mm)

17. Remove input shaft bearing retainer and install shim pack between bearing retainer and input shaft bearing cup. Remove input shaft.
18. Install shift spring into the bottom of the shift well.
19. Check shift fork for excessive wear. Replace if necessary.
20. Check clutch collar for wear or damage in groove, on drive lugs, and splines. Replace if necessary.
21. Apply a thin coat of grease on the clutch collar riding surface area of shift fork.

INTER-AXLE DIFFERENTIAL ASSEMBLY

22. Assemble the shift collar onto the shift fork with flat side of collar up. The fork bushing must also face up. Install the fork and collar into the case and align the hole of the shift fork over the opening of the spring.

23. Apply a thin coat of grease to the small diameter of the shift shaft.

24. Insert shift shaft into cylinder and install through the shift fork hole and the spring. Make sure shaft is seated into the bottom of the shift cylinder.

25. Apply a thin coat of grease to the O-ring of the shift piston.

NOTE: Visually inspect the composite shift piston to insure the steel spacer is present on the bottom of the piston. See page 26 for more piston information.

26. Lubricate and place piston/O-ring assembly into shift cylinder with detailed side facing front for the composite piston and the flat face on the aluminum piston. See Figure 27 on page 26. Seat piston firmly against shift shaft.

27. Install onto the shift cover.

28. Clean the shift cover sealing area and the intermediate case and apply a 1/16 in. bead of Loctite #518 Gasket Eliminator. See Figure 22.

NOTE: Care must be taken to keep Loctite off of piston assembly.

29. Install shift cover.

NOTE: If old bolts are used, coat threads with Loctite #277 before installing.

30. Install four washers and cover bolts. Tighten and torque bolts alternately to 15-20 Lb-Ft (20-27 N-m) until cover is seated properly.

31. Lube bearing and bearing journals then Install the input shaft into the shift collar and lube input shaft bearing.

32. Install new oil seal into input shaft bearing retainer.

33. Clean the mating surfaces of the bearing retainer and the case. Apply a 1/16 in. bead of Loctite #518 Gasket Eliminator to cover mounting surface of case and around each bolt hole. See Figure 22.

34. Install bearing retainer and tighten bolts alternately. Torque bolts 100-120 Lb-Ft (135-163 N-m).

35. Inspect input yoke seal surface for grooves. If grooves can be detected with fingernail, it must be repaired with a CR SPEEDI-SLEEVE® or replaced.

36. Clean and dry threads on input shaft.

37. Install end yoke using installer service tool.

NOTE: Spicer recommends that new flanged hex nuts be used.

38. Apply Loctite #680 (green) to threads.

39. Use torque multiplier and torque input flanged hex nut to 900-1,200 Lb-Ft (1,220-1,627 N-m).

Inter-axle Assembly Complete

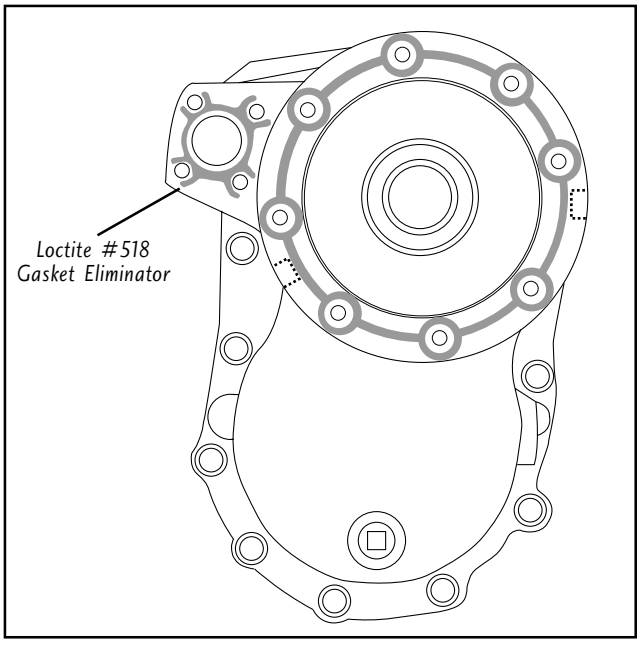


Figure 22

1. Install ring gear and differential assembly into carrier housing. Tilt differential slightly so ring gear clears pinion pilot bearing support.

NOTE: Care should be used when installing ring gear and differential into carrier housing so damage to ring gear, pinion, bearings, or bearing bores does not occur.

2. Differential bearings should be lubricated and bearing cups should be cleaned and #620 loctite applied to the O.D. of the bearings.
3. Be sure side bearing cups are seated on bearing cones. Assemble differential bearing caps with match marks in proper location. Clean bearing cap bolts and washers and coat threads with Loctite #277(red).
4. Install bearing cap bolts and tighten enough to eliminate visible space between differential bearing cap and carrier. Do not torque bolts at this time.

NOTE: Differential assembly must be aligned within bearing bores before preload is applied or damage to bearings can occur.

5. Install adjusting rings. Tighten both adjusting rings until end play is eliminated, and there is backlash between the ring gear and pinion. See Figure 23.

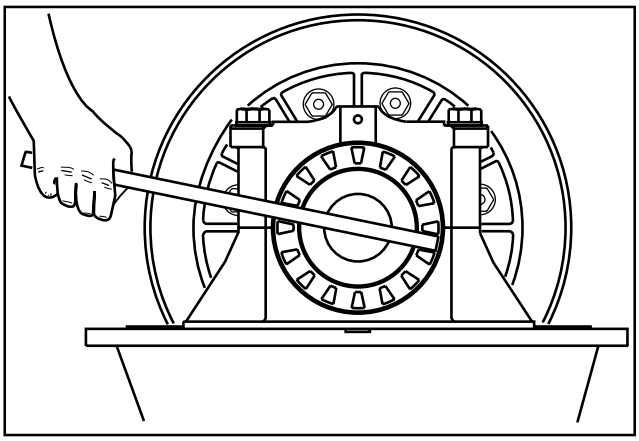


Figure 23

6. Loosen adjusting ring on tooth side of ring gear 1 notch and tighten adjusting ring on flange side of ring gear 1 notch. Repeat process until backlash is elminated. Tighten adjusting ring on tooth side of ring gear until the ring gear and pinion backlash matches the backlash etched on the ring gear. This adjustment sets both the backlash and the bearing preload.
7. Check ring gear and pinion backlash in four equally spaced positions aound the ring gear with a dial indicator as shown.
   Acceptable backlash tolerance is +/- .002" from backlash etched on ring gear. (See Figure 24.)

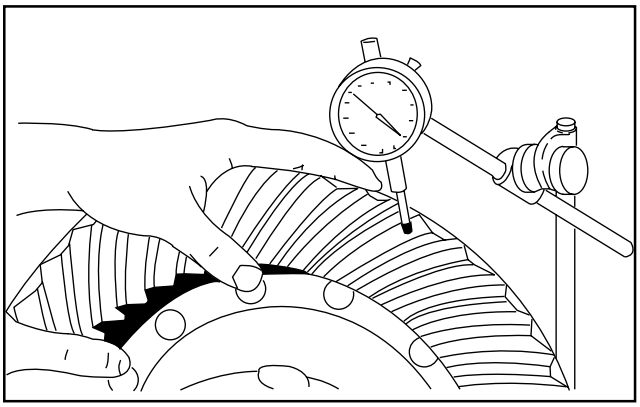


Figure 24

NOTE: If the backlash tolerance varies more than .003" (.080mm) between the four positions, remove the differential and determine the cause.

8. Once the backlash is set, torque the differential bearing cap bolts to 295-340 Lb-Ft (400-461 N-m). Check backlash after torquing cap bolts.

Differential Installation Complete

RING GEAR AND PINION TOOTH CONTACT PATTERN

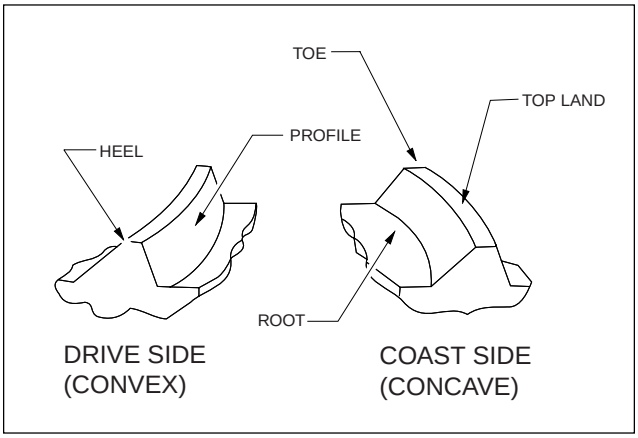
The procedures to the right are to be used to establish proper gear tooth pattern after assembly of the carrier is complete.

NOTE: If matched sets are being reused, measure and record backlash before disassembly, and reassemble to the same backlash. This will match ring and pinion gears to the established wear patterns. Hand rolled patterns will cover less area than the gear pattern established by previous service.

The GLEASON gear set is identified by a 390GA100 series part number. The ORLIKON is identified by a 390GA200 series part number. (See Gear Set Identification section.)

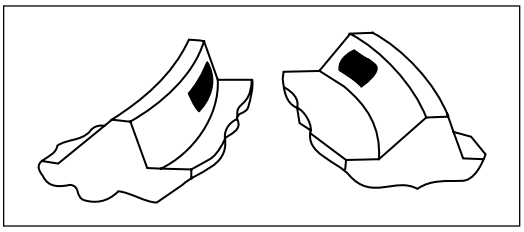
STEP 1. Paint 1/4 ring gear with marking compound on both the drive and coast side.

STEP 2. Rotate ring gear at least one complete revolution in both directions while load is being applied.

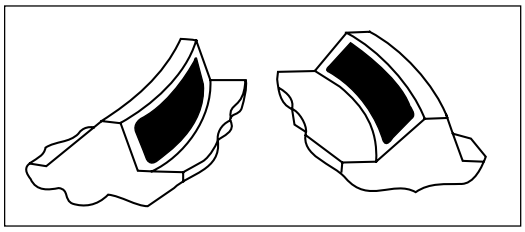


CORRECT GEAR PATTERNS FOR GLEASON CUT GEARS

LIGHTLY LOADED

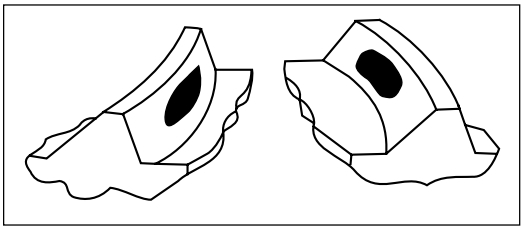


HEAVILY LOADED



CORRECT GEAR PATTERNS FOR ORLIKON CUT GEARS

LIGHTLY LOADED



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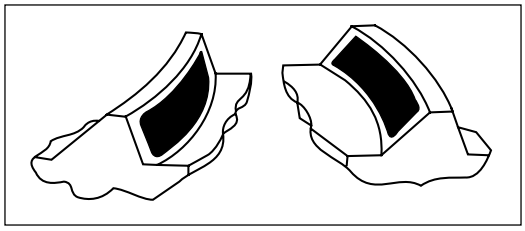
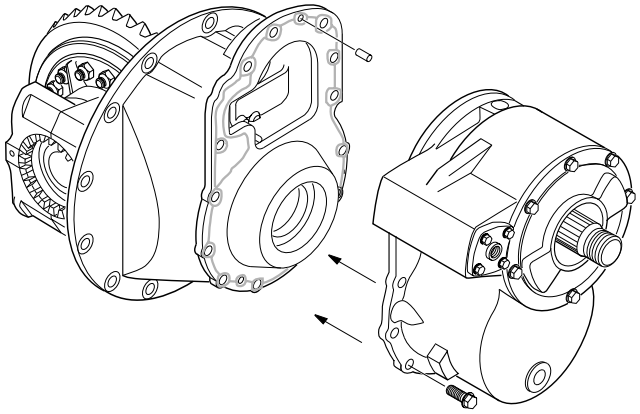
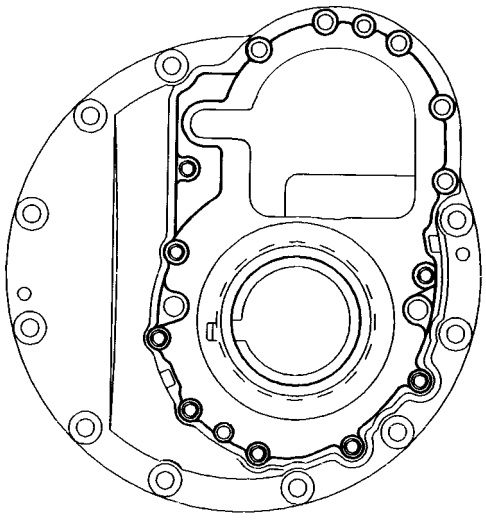


NOTE: Tooth contact pattern, on this axle model, can be moved only by adjusting backlash. The contact pattern can be moved in the direction of heel-to-toe, and toe-to-heel; Depth of the pattern cannot be adjusted. If an acceptable tooth contact pattern cannot be established within limits of backlash, contact Spicer Service at 1-800-666-8688.

INSTALLATION OF INTER-AXLE DIFFERNETIAL TO CARRIER

1. Thoroughly clean mating face of carrier and apply an 1/8 inch bead of Loctite #518 Gasket Eliminator. See Figure 19 for correct bead pattern.
2. Align inter-axle differential case with carrier housing and insert bolts and torque to 160-180 Lb-Ft (217-244 N-m).





#518 Gasket Eliminator Bead Pattern

Figure 19

YOKE REMOVAL AND SEAL REPLACEMENT

1. Disconnect drive shaft at the rear U-joint.
2. Remove yoke nut.

NOTE: Use of torque multiplier is recommended as torque specification on input flanged hex nut is 900-1,200 Lb-Ft (1,220-1,627 N-m).

3. Remove end yoke using the yoke remover tool. See Figure 25.
4. Remove oil seal.
5. Inspect end yoke seal surface for grooves. If grooves can be detected with fingernail, it should be repaired with a CR SPEEDI-SLEEVE® or replaced.
6. Clean and dry threads on input/ouput shaft or pinion. Install oil seal using proper tools.
7. Install end yoke using yoke installer. See Figure 17 on page 17.

NOTE: Spicer recommends that new flanged hex nuts be used.

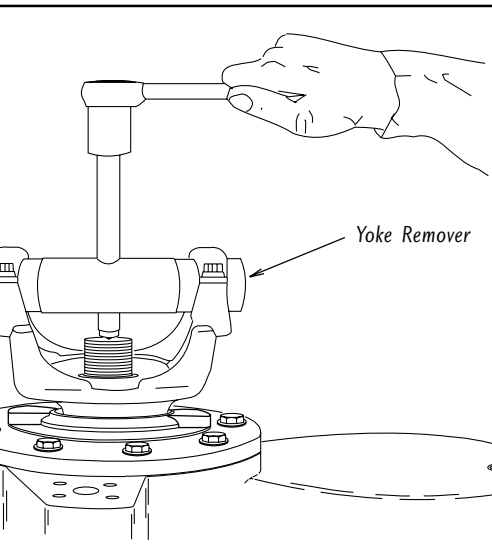


Figure 25

8. Apply Loctite #680 (green) to threads.
9. Use torque multiplier and torque flanged hex nut to 900-1,200 Lb-Ft (1,220-1,627 N-m).

Yoke Removal and Seal Replacement Complete

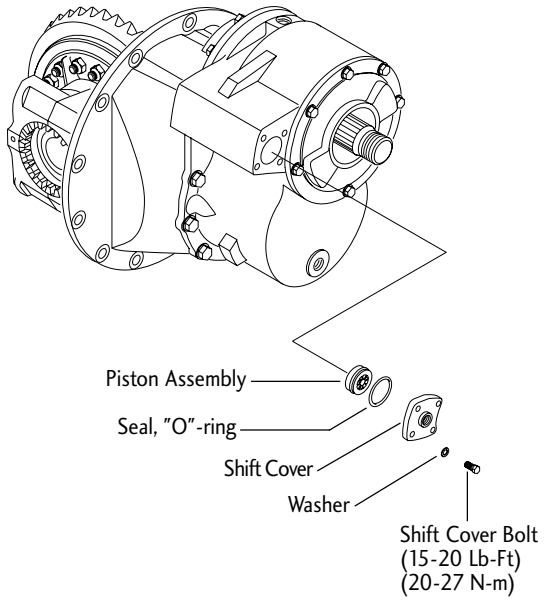
SHIFT CYLINDER SERVICE

DISASSEMBLY

1. Disconnect air line from power divider.
2. Remove shift cylinder cover bolts and washers.
3. Remove cover and O-ring seal.
4. Pull shift cylinder piston assembly from carrier.
5. Inspect all components for wear.

NOTE: Do not remove shift fork shaft from assembly.

Disassembly Complete



ASSEMBLY

NOTE: Visually inspect the composite shift piston to insure the steel spacer is present on the bottom of the piston.

1. Inspect all new components.
2. Lubricate and place piston/O-ring assembly into shift cylinder with detailed side facing front for the composite piston and the flat face on the aluminum piston. See Figure 27. Seat piston firmly against shift shaft.

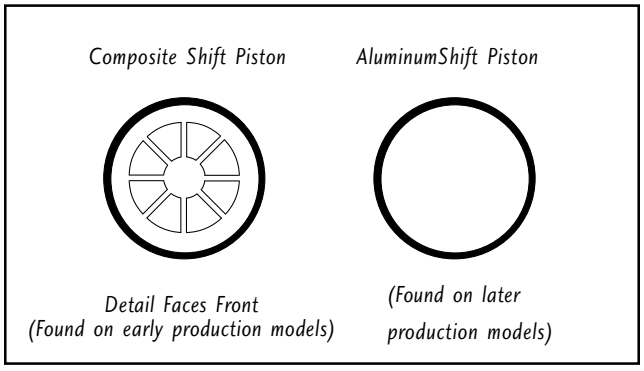


Figure 27

NOTE: Care must be taken to keep Loctite off of piston assembly.

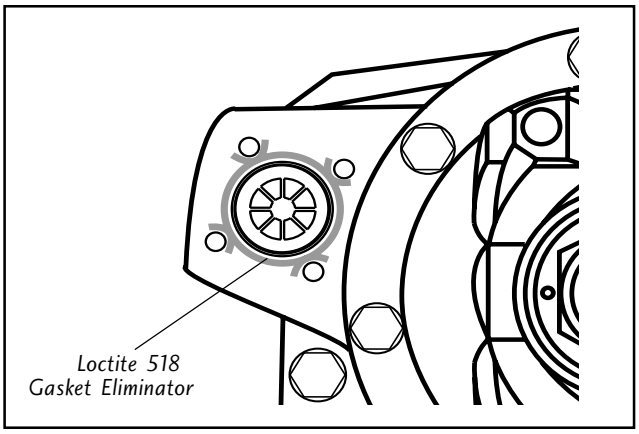


Figure 28

3. Clean the shift cover sealing area and the intermediate case and apply a 1/16 in. bead of Loctite #518 Gasket Eliminator. See Figure 28.
4. Install shift cover and tighten bolts to precribed torque. 15-20 Lb-Ft(20-27N-m)

NOTE: If old bolts are to be used, coat threads with Loctite #277 before installing.

5. Install washers and cover bolts. Tighten bolts alternately to 15-20 Lb-Ft (20-27 N-m) until shift cover is seated properly.
6. Connect air line to power divider.

Assembly Complete

INSTALLATION OF DIFFERENTIAL CARRIER INTO AXLE HOUSING

1. Thoroughly clean the inside of the carrier housing and inspect the housing mounting surface for nicks and general cleanliness. Stone the surface if necessary to remove burrs or nicks.

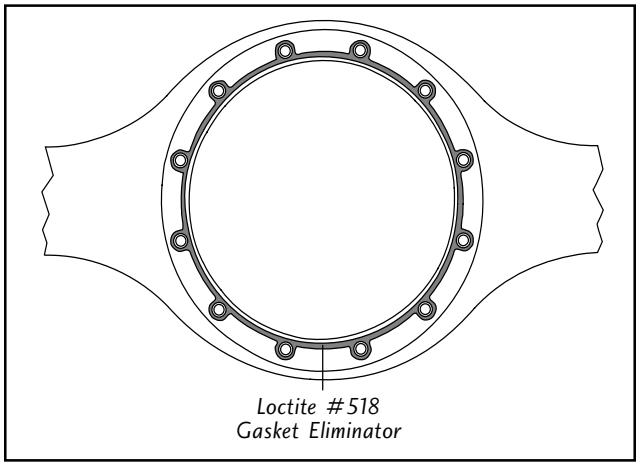


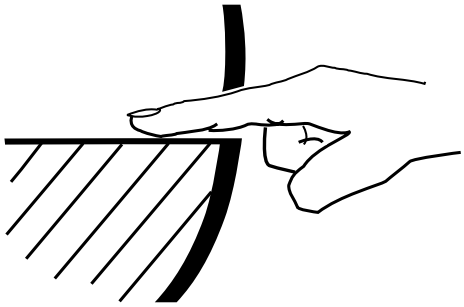
Figure 29

2. Apply an 1/8 inch bead of Loctite #518 Gasket Eliminator onto the axle housing mounting flange and around each bolt hole. See Figure 29.
3. Thread 2 studs or guide pins into the axle housing 180^0 apart. This will eliminate rotation of the carrier assembly after it makes contact with the gasket material.

NOTE: Use guide pins to install forward carrier assembly with output shaft in housing. Align splines of output shaft and rear gear of inter-axle differential. This will help align carrier and output shaft during installation and prevent any unnecessary weight on output shaft bearing.

4. Install the carrier assembly into the axle housing. Clean the mounting bolts and coat with Loctite #277 (red), or its equivalent , and install Tighten bolts evenly in cross pattern. Torque bolts 240-260 Lb-Ft (330-338 N-m).
5. Allow one hour cure time for gasket material before adding hypoid gear lubricant.
6. Remove the old axle flange gasket and clean mating surfaces of the hub and axle flange.
7. Install the new axle flange gasket.
8. Install the axle shafts in proper location. Torque the axle flange nuts to vehicle manufacturers specifications.
9. Clean drain plug and fill unit to proper level with hypoid gear lubricant.
10. Apply Loctite #565, or its equivalent, to drain plug threads. Insert and torque to 35-45Lb-Ft (47-61N-m).

Differential Installation Complete



NOTE : Lubricant close enough to bottom of fill hole to be seen or touched is not sufficient. Lubricant must be level with the fill hole.

CAPACITIES (Approximate):

Axle	Pints	Liters
Forward Rear *	30	14
Rear Rear **	25	11.7

** Lube capacity is based on a 4^0 installation angle*
*** Lube capacity is based on a 11^0 installation angle*

AXLE / TORQUE SPECIFICATIONS

S400-S Specifications

Position	U.S.	Metric
Pinion Torque		
Bearing Preload (Torque Wrench)*	10 - 40 Lb-in	1.1 - 4.5 N-m
Differential		
Ring Gear to Pinion Backlash	.008 - .012 in.	.30 - .40 mm
Lubrication (Approx.**)		
Forward Rear	30 Pts.	14 Liters
Rear Rear	25 Pts.	11.7 Liters

** Pinion bearing preload is established prior to installation of pinion seal.*

*** Capacity will vary depending on the housing angle in each vehicle. Fill to lower edge of fill hole in rear of axle housing as shown on Page 27.*

Forward Rear Fasteners

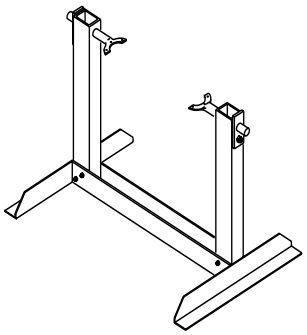
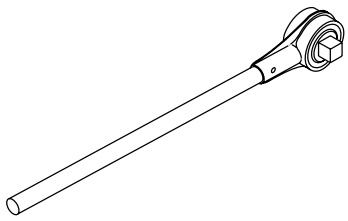
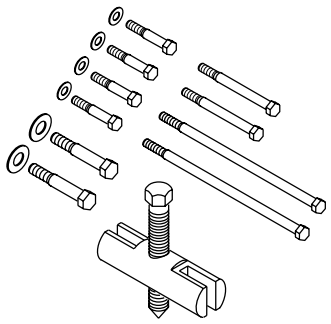
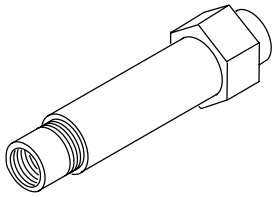
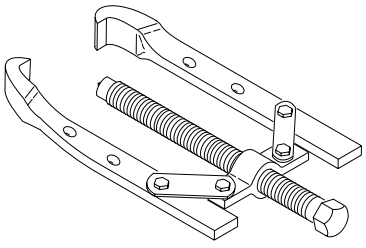
Position	Thread size	Grade	Lb-Ft	N-m
Flanged Hex Nut	1 3/4– 12	–	900 - 1,200	1,220 - 1,627
Carrier Mounting Bolts	5/8 – 11	8	240 - 260	330 - 358
Fill Plugs	3/4 – 14	–	35 - 45	47 - 61
Temperature Sensor Plug	1/2 – 14	–	35 - 45	47 - 61
Magnetic Drain Plug	3/4 – 14	–	35 - 45	47 - 61
Shift Cylinder Cap Bolts	5/16 – 18	8	15 - 20	20 - 27
Inter-Axle Differential Case Bolts	9/16 – 12	8	160 - 180	217 - 244
Lube RetainerBolts	3/8 – 16	8	20 - 25	27 - 34

Rear Rear Fasteners

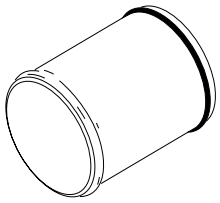
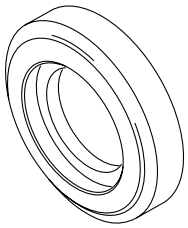
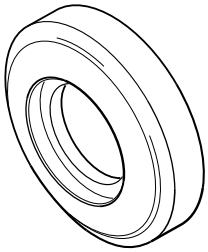
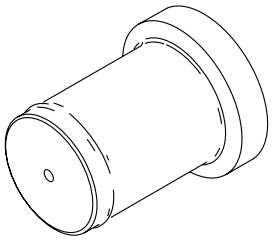
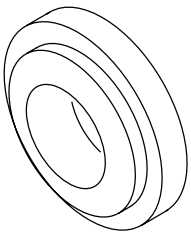
Position	Thread size	Grade	Lb-Ft	N-m
Flanged Hex Nut	1 3/4 – 12	–	900 - 1,200	1,220 - 1,627
Carrier Mounting Bolts	5/8 – 11	8	240 - 260	330 - 358
Fill Plug	3/4 – 14	–	35 - 45	47 - 61
Temperature Sensor Plug	1/2 – 14	–	35 - 45	47 - 61
Magnetic Drain Plug	3/4 – 14	–	35 - 45	47 - 61

NOTE: Refer to vehicle manufactures specifications for Axle Flange - Wheel Nut fastener torque requirements.

RECOMMENDED SERVICE TOOLS

ORDER NUMBER	ILLUSTRATION	DESCRIPTION
DST1001		CARRIER STAND
DST1002 DST1003 DST1004 DST1005		TORQUE MULTIPLIERS Maximum 1,000 Lb-Ft Maximum 2,000 Lb-Ft Maximum 4,000 Lb-Ft Maximum 12,000 Lb-Ft
DST1006		YOKE REMOVER, BAR TYPE
DST1007		YOKE INSTALLER (1-3/4"-12)
DST1008		LONG, 2-JAW, PULLER

RECOMMENDED SERVICE TOOLS

DST1000 S400 SERVICE KIT		
ORDER NUMBER	**ILLUSTRATION**	**DESCRIPTION**
DST1000-1		SEAL INSTALLATION HANDLE (To be used with seal installers listed below)
DST1000-2		INPUT SHAFT SEAL INSTALLER OUTPUT SHAFT SEAL INSTALLER
DST1000-3		PINION SEAL INSTALLER
DST1000-4		OUTPUT SHAFT BEARING/ BEARING ASSEMBLY INSTALLER (To be used with 2-jaw puller)
DST1000-5		OUTPUT SHAFT REMOVER ADAPTER (To be used with yoke installer DST 1007)

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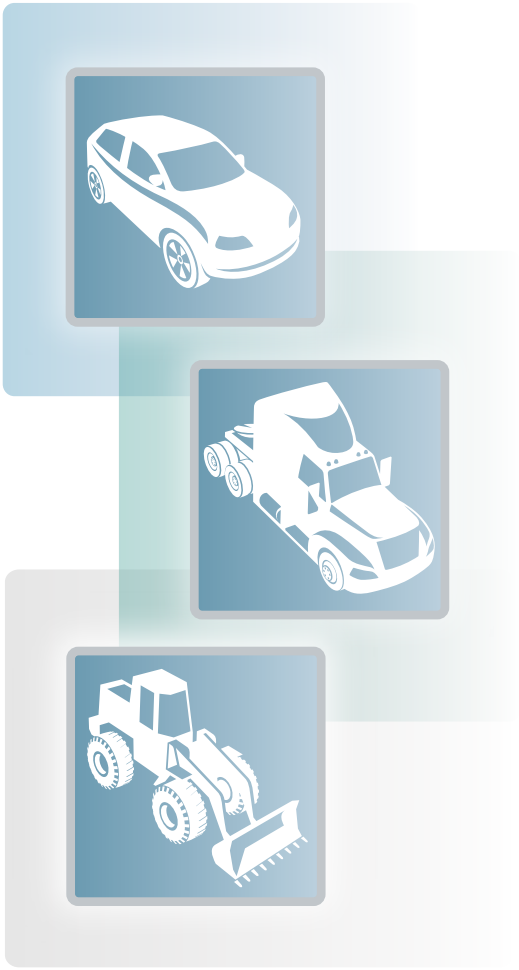

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